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EDITORIAL NOTES—GAS, &c.

Gas-Works Electricity Installations.

IN "Electricity Supply Memoranda" this week, the proceedings at the somewhat protracted inquiry that has lately taken place into the new regulations that the Home Office propose to impose upon the generation and use of electricity in factories, workshops, and such-like establishments are reviewed in respect of certain of the main features. Many gas-works administrators and engineers have, however, an interest in these regulations altogether apart from their position as competitors with electricity undertakings for power and lighting in and upon premises in which industrial operations of all kinds are carried on. To-day many a gas-works possesses small but well-equipped electricity generating-stations, in which gas is used as the driving agent, and the current is employed for motive power purposes about the works. Some of our electrical friends cannot understand this, and try to make capital out of it in the localities in which they are situated. But, as a matter of fact, they would be well advised, in their own interests, to say as little about this as possible, as these gas-driven plants have served as very useful object-lessons to manufacturers in respect of costs, reliability, and perfection of control compared with public supplies. But for the information of the cynics, and those who cry "Practice what you preach," it may be well to reiterate a statement that has been made before—that the generation and use of electricity in a number of gas-works in this country has come about solely through the new retort charging and discharging machines which travel up and down the floor of the retort-houses, and for which travelling machinery electricity has been found particularly convenient. But the work of these retort charging and discharging machines in most gas-works is of an intermittent character; and no one knows better than the central station electrical engineer the value of a good and constant load in reducing generating costs to the minimum. Hence, where there are these generating plants, the use of electric motors for operating other plant about the gas-works.

With these preliminary remarks, we may turn to the Home Office regulations which will apply to these gas-works electricity generating plants in common with other establishments—central generating stations among them—in which electricity is generated and used; but for some of the details of the regulations, we must refer readers to the "Electricity Supply Memoranda." From the point of view of gas engineers, there will not be the slightest objection to making their works' electricity installations as perfect in the matter of safety as is possible, as (quite apart from the ever-threatening Employers' Liability and Workmen's Compensation Acts) in gas-works, above all places, such plants should be, as there has been every endeavour to make them, above suspicion. Absence of accident on gas-works where there are these electricity generating plants, has pointed to the success of the endeavour; and what has been done, to a very large extent conforms installations to the regulations that the Home Office are now engaged in finally putting into shape. The only objection, and it is a very real objection, that can be advanced against the regulations is that District Inspectors of the Home Office may, by putting a too liberal interpretation upon the regulations, enhance the cost of making these comparatively small installations. But it will be seen that the inquiry already referred to brought about some modification of the proposed requirements of the department, and annexed to certain of the regulations there now appear the words "so far as is practicable." It can well be imagined that, from the date of the application of the regulations, around the question of practicability there will be frequent discussion between inspectors and responsible engineers. But there is some satisfaction in knowing that appeal from the District Inspectors to the Chief Electrical Inspector of Factories (Mr. G. Scott Ram) will be possible. In the interests of amicable relations between gas-works owning electricity plants and District Inspectors, recourse to an appeal should not be made more frequently than real necessity demands; and we cannot, upon carefully surveying the position, think that such necessity will often arise.

Of supreme importance in connection with the regulations is the question of voltage. The old regulations of the Board of Trade put the danger-line at 250 volts; but those regulations were made at a time when the uses of electricity had not got much beyond a restricted employment for private lighting. But the conditions are changed now that electricity is used to a fairly considerable extent in factories and workshops for power and other purposes, in which factories and workshops the highest intelligence is not always found, but carelessness and the contempt bred by familiarity abound, and in company with such conditions are bare terminals, wires, and metal alive with electricity. Accidents to men happen in consequence, of which accidents public report is not made, unless unhappily they have a fatal ending. Impressed by the results of his four years' study of the changed conditions, the Chief Electrical Inspector of the Home Office, in the drafting of the new regulations for industrial establishments, has lowered the danger-line to 65 volts for alternating current, and 130 volts for continuous current; and all the indications are that from these voltages the department are immovable. But all that the lowering of the danger-line means is that, in all industrial establishments using electricity at above the voltages named, the electrical equipment will have to comply with the regulations; in other words, the voltages have been deliberately fixed upon as the absolute highest points of safety to which the department are prepared to go without requiring the application of precautionary measures. In connection with the De Brouwer machinery, in this country, we know there are one or two continuous current electrical installations in which the voltage is as low as 110. These will not come under the new regulations. But we believe that, generally speaking, the voltages of the installations are 220 or 440; and these will therefore all come under the new regulations.

As we have intimated, these gas-works electricity installations already, up to a certain point, comply with the regulations, as the requirements have been looked upon from the first by the contractors as essential to successful and safe operation. Use is made of the expression "up "to a certain point," because what has been done it cannot be claimed completely comprehends the proposed new requirements. Now, for instance, it is contemplated that all switches shall be enclosed in such a way that a man cannot by any possible chance touch the live portions; and all bare screws and connections which might at times be alive are to be covered effectually in order that there cannot be personal contact by accident. But here, again, every part that could cause a shock to a man has, in most cases, been enclosed or put in such a position that no one would likely get against it except by gross carelessness. Then, further, all motors are to be fitted with fuses, or with effective automatic cut-outs on the machines. In the De Brouwer installations, main fuses are always to be found on the switchboard and cut-outs on the machines; and we believe that where gas-works have insured their electrical installations, fuses on the machines have had to be installed in the circuit to each motor before the Insurance Companies concerned would take over and maintain the installation. Therefore, gas-works installations in most cases will not, from our reading of the regulations, fall far short of compliance with the demands under the new order of things. Talking of Insurance Companies, reminds that there has been in one or two instances, some little trouble in fulfilling one of the conditions imposed by them, and that is in the effective earthing of all the motors. In opposition to this condition, it has been maintained, and very reasonably, that, if the

motor stands on an iron frame, and runs on an iron rail in the floor, the machine must be as efficiently earthed as a moving machine can be. But in spite of this, some of the inspectors have raised difficulties, because they think it necessary to earth each motor separately. We cannot see how this is ever to be done on a travelling machine. As a matter of fact, it has never been done; and, usually, the installations are accepted after some one of a technical grade higher than the ordinary inspector has visited the works to see exactly what is necessary.

From these various considerations, though the Home Office regulations will apply to the electricity installations of gas-works, we venture to think they are not likely to cause much trouble or concern, though they will add a little to the expense, because at the present time switch-boards are left open and unprotected in an engine-room, and will have to be guarded in some way—by a lock-up cupboard, or other means—so that no one but proper authorized persons can interfere with them. As in the case of all Home Office regulations, a good deal will depend upon the Inspector. If he is a *persona grata* at the works, well and good; if otherwise, there may be difficulties, though no inspector can compel more than is comprised in the regulations, and, if his requirements are impracticable, there is always the appeal to a higher quarter.

Town Gas and the Gas-Engine—
Weak Mixtures and Efficiencies.

It is not a satisfactory condition of things that, when the gas-engine is under discussion at meetings of engineers who are in a position to largely influence the use of gas for power purposes, the voice of the engineer representing town gas is never heard. The result is that, on such occasions, those representing and favouring producer gas of various brands have things much their own way; and the civil and mechanical engineers alike who are not specialists on the internal combustion engine are duly impressed that producer gas for power purposes is now the correct thing, and that coal gas in this direction has had its day. In the study of the theory of the gas-engine, and in the prosecution of research, it is becoming rare to hear that town gas is the agent that has been employed; and this is due entirely to the fact that the producer gas people keep themselves in greater evidence and offer greater facilities, and do more to encourage research, than the distributors of town gas. The consequence is that the extension of knowledge of the theoretical conditions supplying the base of improvement and higher efficiency is being entirely obtained in the field of the competitors of distributed town gas. It is not good to argue that the study of the theory of the gas-engine and the results of research that tend to improvement are immaterial to those who make and distribute gas for sale. The distant attitude of the gas manufacturer, in fact, seems to find expression in this: "We do not make engines, we only sell "gas for them, and therefore their advance in improvement "and efficiency is entirely a matter for the engine makers. "We have really no concern in anything but the practical "work of the completed article; and with us the best engines "will receive favour." This is a mistaken attitude, and that it is so is seen in the fact that gas-engine makers and distributors of town gas are now pulling very largely at opposite ends of the rope, while at the gas-engine makers' end are found collaborating with them the producer-gas and suction-gas people. If gas engineers would only display greater interest in what some choose to scoff at as academical work in connection with gas-engines (it is the work that has directed the way to greater economy and efficiency), and take part in its discussion at the meetings of engineers engaged in other branches of the profession, the use of town gas for power purposes would be kept more prominently in view, and would receive greater consideration, instead of being relegated by other than gas engineers into a secondary and neglected position. We undoubtedly want to keep up the end of town gas among those who have influence with power users.

Matters affecting gas-engines were under discussion at the last meeting for the past session of the Institution of Mechanical Engineers, which was attended by considerable numbers of engineers; but town gas was hardly heard of, excepting for the circumstance that, in the investigations one of the authors had used it, because it was convenient for his purpose. Even this investigator admitted, in his reply to the discussion, that, if he were carrying out tests for practical work, he would naturally use producer gas. The first of the two papers under discussion at the meeting was by Mr. James Atkinson; and extracts from it appeared last week. The second was by Professor Bertram Hopkinson, of the University of Cambridge. Selected parts of this contribution are published in to-day's issue. It is to this paper that it is desired now to briefly refer; as the results of the tests that the Professor made in his inquiry into the effect of mixture strength on thermal efficiency in gas-engines have more than a skin contact with current gas policy. We hear a great deal about calorific value in these days; but it is quite possible that calorific value will in future be, to an extent, controlled by local conditions, and the character of the gas business that is available in any given area. Where practically the whole of the gas is used for incandescent lighting and heating and cooking purposes, and little for power, the cheapest gas may be one of a fairly high calorific value, but upon which gas there is no unnecessary expenditure to procure illuminating power. In a manufacturing district, in which a considerable proportion of the gas is used for motive power, a gas of lower calorific power at a lower price may, however, be the gas that is most profitable.

Thoughts are directed in this channel by Professor Hopkinson's paper. In his investigation of the effects of mixture strengths on efficiency, he used, contrary to latter-day custom in gas-engine research, town gas with the lower line of calorific power at about 600 B.Th.U.; and the results of his experiments showed conclusively that, as the gas percentage of the engine cylinder contents was reduced within, of course, certain limits—that is to say, as weaker mixtures were used—the efficiencies were higher. The weakest mixture used in the tests contained about 8·65 per cent. of coal gas when in the engine; the proportion of air to gas being drawn in being about 9½ to 1. Weaker mixtures than this would not ignite regularly. At the other end of the range, the proportion of air to gas was about 7½ to 1. Slightly heavier charges than this could be used; but it is possible that the combustion would not be complete, and the pressures in the engine would become dangerously high. The range of mixtures therefore covers all that could be practically used. Now this is the important point, that, within the range specified, efficiency diminishes steadily as the strength of the mixture increases; or, to put the converse, as the strength of the mixture decreases within those limits, efficiency increases—the difference between the weakest and the strongest charge amounting to 4½ per cent in efficiency, or 12 per cent. on the work done. The causes producing these interesting facts are fully discussed in the paper. In confirmation of the results, Mr. J. Emerson Dowson quoted others, in the discussion, which had proved to his formerly sceptical mind how easy it is to get good mean pressures and heat efficiencies in a gas-engine with a poor gas—that is to say, a gas of even such low calorific power as from 100 to 120 B.Th.U. Piecing together the results of Professor Hopkinson and those of Mr. Dowson, they have an important bearing on the question of the general distribution of a lower grade and cheap gas in districts where there is a considerable business to be done in gas for power purposes. At any rate, they open up a large channel for thought. The idea of making producer gas and coal gas in a combined setting has been recently brought before us. Is the gas-engine going to invite gas manufacturers in areas teeming with industry to seriously consider some such combination?

Home Conditions Reflected in Australia.

The report of the proceedings at the second annual meeting of the Victorian Gas Managers' Association has been received from the Hon. Secretary and Treasurer (Mr. P. C. Holmes Hunt); and it is with considerable pleasure that we reproduce it in our columns, and especially the address of the President (the Hon. George Swinburne, Assoc.M.Inst.C.E.), the Managing Director of the Colonial Gas Association, Limited. Technically, the proceedings will not afford our readers any substantial amount of fresh food; but these annual reports of the meetings give us an answer to the question, How fares it with our professional *confrères* in Australia? The chief impressions that one gains from the report on this occasion are two. In the first place, the universality of the gas industry is borne upon us; and, in the second place, we are impressed to the point of admiration by the manner in which even the smallest of these distant gas undertakings keeps abreast of the times in the matter

of new plant and method, so far as its opportunities and dimensions will allow. The universality of the gas industry is portrayed in its successes and in its difficulties. Whether we look into Mr. Swinburne's address or into the discussion that took place at the meeting on the use of regenerative furnaces in small works, there we see that in Australia as here the business in gas continues to expand, and, in the production of the staple commodity there is, year by year, a greater recovery, as well as of the other marketable products, from every ton of coal carbonized. Such things are satisfactory. But the gas managements have difficulties that are akin to those of the gas managements in the Mother Country.

For example, in Australia increased prices are now being paid for coal; and this is largely due to the enlarged demand from foreign countries. There are, among the gas managers who were assembled at this meeting, those who think that there should be an export duty on the coal taken out of the country. That is purely a reflection of the gas coal position at home. Then it has been proposed that there should be an amalgamation of the small companies of the State for the purpose of purchasing their coal supplies. It is submitted, however, that there is an objection to this, that there is only one district from which coal can be bought; and that, there being no other districts in competition, the coal owners could easily ensure that they were not the losers in consequence of amalgamation. That is the argument; and, not having a close acquaintance with the local conditions, we cannot contest it. But it may be taken that there are a number of coal owners in the coal region, and that they are in competition; and, therefore, in the ordinary course of things, it would be expected that a lump contract for coal would be competed for much more seriously than small divisions of that lump. The coal owners of Australia, like British coal owners, also look upon gas coal buyers as being very favourably situated for paying them high prices for the coal required for gas making, as they sell the products of the coal, and have the gas consumer upon whom to call to pay the additional cost of coal. It is short-sighted policy of coal owners in any part of the world to oppress such excellent all-the-year-round customers as gas manufacturers, as upon the lowness of the price of gas depends largely the success of the business; and the greater that success, the greater the expansion of the demand for gas coal. The smallest of the gas undertakings in Australia badly want all the encouragement they can get, in their isolated towns, with comparatively few customers per mile of main, and such prices for gas as 7s. 6d., 10s., 12s. 6d., and 14s. per 1000 cubic feet. In such places, every effort is being made to reduce expenses and the price of gas; and it is a decided novelty to read in the President's Address of single reductions of 4s. 2d. and 2s. 6d. per 1000 cubic feet being made in the praiseworthy effort to cultivate a larger business, and so automatically to reduce the standing, manufacturing, distribution, and other charges per 1000 cubic feet of gas sold.

In this country, we have had, and still have, to complain of a detrimental injustice to gas by the undue favour accorded to electricity in its freedom from a like measure of statutory restriction in the conduct of business, and in its considerate and special treatment under municipal management. Australian gas undertakings also have their grievance regarding the favouring of electricity. The duties on imported gas appliances are already sufficiently heavy to have secured, to a very large extent, their manufacture in the country; but now there is a proposal to double the duties—for instance, from 12½ to 25 per cent. on gas-meters, and from 15 per cent. to 30 per cent. on incandescent mantles—while the advances that are to be made in respect of electrical appliances are slight compared with what even formerly existed on gas appliances. For example, electricity meters have now been brought from the free list to the low duty of 5 per cent., while carbons for electric arc lamps continue on the free list, excepting those of foreign manufacture, which have only a 5 per cent. duty imposed on them. If there is to be a duty of 25 per cent. on gas-meters and 30 per cent. on incandescent mantles, why not 25 per cent. on electricity meters and 30 per cent. on carbons? There should be fairness to industries, and especially to old industries. There is no doubt the distinction has been proposed with the idea of helping a comparatively new industry; but help should not be rendered by perpetuating a gross injustice upon an existing industry. Such low duties on electrical appliances will not conduce to the establishment of the manufacture of electrical appliances in the country; so that while injuring one industry, the State is not being benefited by the other. The Victorian gas managers at their meeting made their protest against this injustice in a resolution, which the Hon. Secretary duly forwarded to the Minister of Customs. We hope that this protest, united with others that have been made, has had the desired effect; and that the gas industry of Australia will be allowed to work out its own destiny in the service of the public without fetter, or, if fettered at all, in measure corresponding only to that which is inflicted upon the competing industry.

Freeing Gas Coke from Arsenic.

As a paper published in this issue shows, Mr. Henry O'Connor and Dr. Drinkwater have accomplished a very useful piece of work for the gas industry and for maltsters. By careful and persistent experiment, they have secured, by the most simple of means, a big effect. An epidemic of arsenical poisoning at the end of 1900 and the beginning of 1901 brought gas coke, it will be remembered, into serious disrepute with maltsters, and their fuel custom went largely over to anthracite. The two experimenters regarded the matter, as it indeed was, as a grave one for many gas-works; and they therefore set to work to see what could be done to make gas coke satisfactory as fuel in malting, by eliminating the arsenic. The result of preliminary experiments was a conviction that some method of volatilizing the arsenic during the process of the manufacture of the coke would be the best, if not the only way, of solving the difficulty. The tests of Mr. O'Connor and Dr. Drinkwater cover a wide range of experimenting; and the problem was attacked by all the direct and indirect means which united thought could devise. Sprinkling the coal before carbonization with common salt came out as the most effective plan; and about 2 oz. of salt per ton of coal has proved ample. Coal containing 1·66 grains of arsenious oxide per pound was treated in this manner; and, carbonized at a gas-works in the neighbourhood of Edinburgh, the result was that the coke only gave 0·0055 grain per pound. Work on a large scale has yielded confirmation; and experts and maltsters have given independent testimony—the former to the remarkable purifying effect of the plan (in connection with which the experimenters rightly protected themselves), and the latter of their satisfaction that it enables them to revert to the easily available gas coke, which is a great consideration to them in view of the high price of anthracite.

The Mines Eight Hours Bill.

Adverting to the suggestion that the Directors of Gas Companies should invite their shareholders to address letters to their local representatives in Parliament calling attention to the injurious effect that the Mines Eight Hours Bill will, if it becomes law, have upon the prices of coal and gas, we learn that the Board of the Tottenham and Edmonton Gas Company have forwarded to each of the shareholders in the concern the following form of letter for (if they approve) signature and addressing to their Members of Parliament: "As a consumer of coal and gas, as well as a shareholder in a Gas Company, I shall be injuriously affected by the Coal Mines Eight Hours Bill now before Parliament, if it should become law. It is admitted that the effect of the measure will be to decrease the production of coal; and it appears equally certain that this will add materially to its present high price. The price of gas to consumers will consequently increase, and dividends on gas shares decrease, while it is not clear that corresponding benefits will be conferred on the miners, or that as a whole they are genuinely desirous of the change. As one of your constituents, I sincerely hope that you will oppose the Bill in Parliament." The form of letter sent out by the Directors of South London gas companies to their shareholders was published in the editorial columns last week.

Electricity and the Franco-British Exhibition.

An effort has been made to push forward a scheme for an exhibit of electrical appliances at the Franco-British Exhibition on the lines of the one that the Committee of the Gas Section are promoting by the financial support of the gas-supply industry. But we learn from the "Electrician" that the combined electrical exhibit has been abandoned. Our contemporary states that the electricity supply companies had promised financial aid, and many prominent manufacturers and contractors decided to take

part. There appears, however, to "have been a singular lack of business promptitude on the part of the exhibition authorities." Negotiations were so protracted that, when details were finally arranged, the manufacturers felt there was insufficient time left for them to do justice to the exhibit before the date of the opening. Many of the most prominent exhibitors thereupon decided to withdraw; the result being that the project has been abandoned. The scheme, in the opinion of our contemporary, should have been carried through even at the risk of the exhibit being incomplete at the date of the opening. There is the Manchester Electricity Exhibition calling for attention this year; and the influence of this—the promoters putting into it a considerable amount of energy, and planning the expenditure of a not inconsiderable sum of money—is no doubt being felt among manufacturers of electrical plant and appliances. There is a little confusion in the electrical industry as to those who are taking part in the Gas Section of the Franco-British Exhibition. It is being financed entirely by the gas supply industry; and the manufacturers of apparatus and appliances are not taking any part in this.

In the Cornish Riviera.

The Penzance Gas Company are to be congratulated on the progress of which the extension of the works inaugurated last week is at once a symbol and a result. It is true that development in a district like Penzance is not to be compared with that of manufacturing towns; but it is steady, if not rapid, and as the Cornish Riviera is being constantly boomed, the town and the Gas Company may look to the future with increasing hope and confidence. There are certainly few places of which it can be said, as it was said of Penzance in the course of last week's proceedings at the gas-works, that there is not in the town a house to let. Penzance is doing very well from the point of view of its Gas Company, who are displaying commendable enterprise. It is something to be able to boast of the possession of the only three-lift holder in a whole county; while in the matter of incandescent lighting in the public streets, and in the progress made with slot-installations and cookers, the Company are keeping pace with the best modern practice.

The End of their Rope.

The exploits in the promotion of rotten companies of Walter Darby and Henry Warwick Gyde (who at different times have found it convenient to forsake their patronymics) have, we hope, finally closed. They are among those who have paid the gas industry unwelcome attentions by promoting on its excellent reputation certain bubble schemes—such as the West Suburban Gas Company and the Kent County Gas Company. Our readers know what has happened in connection with both these Companies; and they also know that the Liquidator of the West Suburban Company, after the arbitration under which the Uxbridge Gas Company wiped that concern out of existence by purchase, took Counsel's opinion, and decided to lay all the papers before the Public Prosecutor. It is not over this gas promotion, but those in which these men were associated in respect of certain Welsh slate quarries that the arm of the law has laid hold of them, to give them an opportunity of answering a charge of conspiracy. The story stands in an interesting position. Gyde was in the London Bankruptcy Court towards the end of last October; and in the same Court the first meeting of creditors of Darby was called for Monday of last week. No Darby put in an appearance; and it was explained that his absence was due to police court proceedings. Turning to the Mansion House, where the two men were to be offered the opportunity of answering the charge of conspiracy, Darby was not there; and the excuse could not be made that the bankruptcy proceedings were detaining him in another place. No one could reply to the question as to what had become of Darby; so a warrant was issued for his arrest. Gyde did surrender, and was admitted to bail; very heavy sums being fixed after Inspector Ottaway had stated that on May 7, 1898, Gyde had been sentenced at the Central Criminal Court to five years' penal servitude (in the name of Bernard) for obtaining money by false pretences. The summons was taken out against Gyde and Darby by Mr. E. V. Fox, the Examiner in the Companies Winding-up Department of the Board of Trade; and the prosecution attaches considerable importance to the case. Perhaps there are other promotions to which the authorities might also attach importance in the interests of the public.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 177.)

THE Stock Exchange has been entirely under holiday influences, and business was very much contracted. The week opened with rather a dull tendency, and further depression prevailed on Tuesday; the weakness being noticeable in all departments. Gilt-edged securities were affected by rumours of fresh loans, and some disappointment that the monetary position had not become easier. Consols dropped to $87\frac{7}{8}$ for money, and $86\frac{15}{16}$ for the account; while English railway securities were freely offered in connection with labour troubles, especially the threatened strike on the North Eastern Railway. Quite a change subsequently came over the markets; and although business continued on a very small scale, yet Thursday closed with a cheerful feeling—members going away for the holidays hoping for more activity after Easter. Consols closed firmer at $87\frac{1}{16}$ for money, and $87\frac{3}{16}$ for the account; while Home Railways showed a marked improvement in view of large traffics. In the Money Market, there has been a good demand for advances; and as floating supplies on the market are not superabundant, most of the loans falling due at the Bank of England have had to be renewed. The discount market has shown a distinctly firmer tone; but the future course of rates will be to some extent governed by gold movements. Business in the Gas Market has also been extremely quiet. The only changes in value were a rise of $\frac{1}{4}$ in San Paulo, to 13½-14, and 1 in Tuscan debentures, to 99-101. There was a fair amount of dealings recorded on Monday. Commercial debentures changed hands at 83, and Gaslight and Coke ordinary at $97\frac{1}{2}$; but on Wednesday business was done between $96\frac{3}{4}$ and $97\frac{1}{2}$, and in Commercial ordinary up to 108. South Metropolitan ordinary changed hands at $121\frac{1}{2}$, and South Suburban at $118\frac{1}{2}$; while on Thursday, a number of markings were recorded in West Ham ordinary between 100 and 101. As regards secured issues, Gaslight and Coke maximum were dealt in at $88\frac{1}{2}$ and 90; and the debentures at $84\frac{1}{2}$ and $83\frac{1}{2}$. South Metropolitan debentures sold at $84\frac{1}{2}$. The Suburban and Provincial group were almost neglected. Brentford ordinary was done at 243 and 244, and British at $42\frac{3}{8}$. The Continental Companies were also very quiet. Imperial Continental changed hands at 180, European at $23\frac{3}{4}$ and 23, ditto £7 10s. paid at $16\frac{1}{4}$, Malta at 92 and 96. Among the undertakings in the remoter world, Metropolitan of Melbourne debentures marked $100\frac{5}{8}$, Oriental 143 and $143\frac{1}{2}$, Primitiva ordinary $6\frac{13}{16}$, ditto debentures $94\frac{3}{4}$ and 94, ditto preference 5, River Plate $13\frac{7}{8}$ and 14, Buenos Ayres $11\frac{5}{8}$ and $11\frac{3}{4}$, Monte Video $11\frac{3}{8}$, and Bombay $6\frac{1}{4}$.

ELECTRICITY SUPPLY MEMORANDA.

For the Security of Workmen—Protection Better than Warning and Loss of Life—Low Voltage Danger Lines—Shocks, Flexibles, and Motors—"So far as Reasonably Practicable"—Specimen Clauses.

THE Home Office is the Government Department charged with supervising factories, workshops, and such-like; and among other things the Department Inspectors have to look to the provision made for ensuring, as far as possible, the safety of the employees. In 1904, the generation of electricity was certified as a "dangerous trade;" and a few months ago the Home Office issued a series of draft regulations applying to the generation, transformation, and use of electrical energy in factories, workshops, &c. These were the work of Mr. G. Scott Ram, the Chief Electrical Inspector of Factories, and were the result of four years' continuous examination and investigation into the methods of electrical contractors and electrical undertakings throughout the country. The appearance of the draft regulations had the same effect upon the electrical industry as a red rag has upon a bull. They pounced upon them right and left, and, metaphorically speaking, tore them to shreds in their anger. The Home Office asked for a little calm consideration, representation, criticism, or anything else the electrical industry desired to put before them. In the result, the objectors were also invited to appear before a Commissioner, and through counsel discuss the regulations one by one and generally—representatives of the Home Office appearing as it were as the promoters of the regulations, and representatives of the objectors as the opposition. The Commissioner entrusted by the Home Office with the inquiry was Mr. James Swinburne, F.R.S.; and his report is going to be seriously considered by the Department before the regulations are put into final shape. Regulations there is no question there are to be, whether the electrical industry likes them or not; for in regard to electrical installations in workshops and factories, Mr. Ram has been duly impressed with the importance of the fullest protection.

The inquiry lasted for a long time. There was during the proceedings plenty of openly expressed rebellion against the regulations generally, which cannot have the slightest effect upon the Commissioner, who was not charged to decide whether or not the electrical industry is a dangerous one. The Secretary of State having certified that it is, there the matter rests so far as the Commissioner is concerned. All through, the objectors were contending that the list of fatalities in factories and workshops was not a great one; and they protested very strongly when Mr. J. Hunter Gray, who appeared for the Home Office, made reply that the objectors seemed to think that, in order to justify the

rules, it was necessary that the industry must pay a heavy toll of human life. The objectors appeared to pay but little heed to the character of the danger—a danger that is imperceptible to four out of the five senses, and with the safety-line low in the case of the fifth; and so there must be agreement with the axiomatic statement that protection is better in such a case than merely warning a man not to get into danger. There were several other general objections to the regulations, which cover the means and manner of equipment in some detail. It is said that the regulations will hamper progress, and cause unnecessary expense; and that their existence will frighten people, and tend to make them return to gas, or decline to turn from gas to electricity. What nonsense to argue thus, when it is printed in black and white on almost every electricity undertaking's leaflets, that "electricity is safer than gas." Time was when we pointed to the Board of Trade, the Institution of Electrical Engineers, and the Fire Office regulations as a proof that the highest authorities recognize the latent dangers of electricity, and the necessity for great and comprehensive precautions. The answer of one of our electrical contemporaries at the time was that the very existence of all these regulations should make electricity supply the safest of all systems. To follow the line of our contemporary's contention, the additional set of regulations should add further to security. This being so, much of the argument before Mr. Swinburne in opposition to the regulations was totally unnecessary. It was also urged that the regulations were superfluous in view of the existence of the Board of Trade regulations. But the objectors had the ground cut from under their feet so far as this objection went, by being reminded that the objects of the two sets of regulations are completely different—one set being only directed to the safety of the public, and to ensure an efficient supply, while the Home Office set is directed to the safety of workmen in factories, workshops, generating-stations, &c. Dissimilar conditions apply. There is altogether a different state of things between (say) a domestic installation for lighting and a large works installation, where there may be naked live metal and damp conditions such as do not obtain in a private house. However, the Board of Trade were not of a mind to allow their regulations in any way to stand in the road to more efficient protection in workshops, factories, &c.; and, through their Technical Electrical Adviser, the Board told the Commissioner of their willingness to make such amending exceptions as would prevent overlapping of their regulations with those of the Home Office.

One very good reason why the objectors would prefer the Board of Trade regulations to those of the Home Office is that the former draw the line of safety at 250 volts. All sorts of hard things were said of the Home Office proposal to lower the line for such places as their rules will govern to 130 volts for continuous current and 65 volts for alternating current. But it must be remembered that the Board of Trade regulations were framed at a time when electricity was practically used for lighting only, and when every part of the installation could be arranged so as to avoid the possibility of shock. They were not designed to apply to places in which were workmen without technical knowledge of electricity and its dangers; to places where accidental shock might precipitate a workman from a height and inflict fatal injury; and to places where irreparable injury might be inflicted by molten metal striking in the face a workman engaged in putting in a fuse or switching on some particular circuit. In the course of the evidence, Mr. Patchell related the results of some interesting experiments that he had made as to the effect of low voltages on different persons. He set out on these experiments prepossessed by the view that the pressures proposed by the Home Office were too low; but he changed his opinion before he had finished. Other persons took part in the trials; and it was interesting to hear the diverse effects on various people of electric current at the same pressure. But the general effect of the experiments was to prove that the Home Office were not in their regulations putting the danger-line any too low, having regard to the conditions prevailing in workshops and factories. Mr. Patchell concluded his evidence by quoting a sentence from the report of a Committee appointed by the New South Wales Government to inquire into the use of electricity in mines: "Shocks from live wires intentionally left exposed occur most frequently in connection with low-pressure systems, in consequence of the exaggerated ideas of the harmless nature of the shocks produced by them." Remarked Mr. Patchell on this: "Familiarity breeds contempt." There was a great struggle on the part of the objectors over this question of voltage; but the Home Office and Mr. Ram were resolute in the matter. Of course, it is quite impossible, hem things in how one will by rule and regulation, to make them absolutely safe; but from among the *obiter dicta* of Mr. Gray for the Home Office, we draw a remark to the effect that it is silly to leave a precipice unprotected when a hand-rail will prevent people falling over. With that we are fully in accord.

There were numerous matters discussed in the course of the inquiry upon which we cannot touch here. Two or three, however, may have passing allusion bestowed upon them. The question of shocks to men by coming in contact with exposed metal was one; but the objectors were evidently of the view that it was better to leave the metal exposed than to cover it with guards, as this tended to a want of cleanliness. That is to say, cleanliness before safety. Then, again, flexible cords came in for a fair amount of notice; it being now proposed that, in the case of all premises coming under the Factory Acts, flexible lamp-cords connected to plugs in the wall will require to have switches. Mr. Ram states that he knows cases of accident with such lamps with current below 250 volts. The argument was put forward that protection is really dangerous. For example, in the matter of the compulsory fencing of certain parts, it was contended that where other portions of plant are unfenced, workmen might take it that there is no danger. This, to say the least, is an argument very favourable to the application of regulations as broad as may be possible, and applying from a fairly low voltage line. Notices as to danger it was also considered were quite likely to unduly frighten people. In other words, knowing themselves the danger of electricity, the electricians who so argue want the truth kept as dark as possible from the public. A bone of considerable contention was a regulation that every electric motor above ¼-horse power shall be fitted with a no-volt release, which costs from (say) £2 to £5, according to the size of the motor. The objectors were very sensitive over this proposition, particularly the power companies. If insisted upon, it is feared that the expense that will be caused in works patronizing electricity undertakings in the matter of electric driving will be very detrimental to the industry. However, there is no doubt about the motor being the seat of danger. The "Electrician" very naturally doubts the necessity for a general clause of the kind; and for this reason: "Motors beyond a certain size can be adequately protected by fuses in respect to the safety of employees, since large motors would blow the fuses rather than start up. *There is more danger in the case of small motors, which may start up and cause injury without blowing the fuses.*" Among other points was the discussion of the regulation providing for periodical inspection. Even this harmless provision, it was considered, would drive people back to gas. According to Lord Robert Cecil, who appeared for several of the objectors, it would mean that the occupier must have an authorized person, with a considerable amount of technical knowledge, to inspect his apparatus; and the immediate result of this would be that certain consumers would abandon electricity. It seemed all through the arguments that it would require very little to persuade consumers of electricity to forsake it for gas as an agent for power and lighting. Certainly gas can be recommended as the simpler agent for all purposes to which electricity is applied, except traction. Gas does not require to be bound round with so much regulation to secure safety; and its dangers are not of the occult kind that electricity possesses, and which call for an adequate protection of persons and property.

The difficulty with electricity is to get absolute protection against danger. This is seen in the draft rules as they were amended during the hearing for the consideration of the Home Office. Representatives of the department and of the objectors had conferences in the course of the inquiry, and made provisional modifications, in several of which the objectors succeeded in getting inserted the protective words (which weaken the original regulations) "so far as is reasonably practicable." This will be seen from some clauses merely given here as specimens:—

1. All apparatus and conductors shall be sufficient in size and power for the work they are called upon to do; and so constructed, installed, protected, worked, and maintained as to prevent danger, so far as is reasonably practicable.

2. All cables shall either be covered with insulating material, and further efficiently protected where necessary, or they shall be so placed and safeguarded as to prevent danger, so far as is reasonably practicable.

4. Every switch intended to be used for breaking a circuit, and every circuit-breaker, shall be so constructed that it cannot be inadvertently left in partial contact. Every switch intended to be used for breaking a circuit, and every circuit-breaker, shall be so constructed that an arc cannot accidently be maintained.

5. Every fuse and automatic circuit-breaker used instead thereof shall be so constructed and arranged as effectively to interrupt the current before it so exceeds the working rate as to involve danger. It shall be of such construction, or be so guarded or placed, as to prevent danger from overheating, or from arcing or the scattering of hot metal or other substance when it comes into operation. Every fuse shall be either of such construction or so protected by a switch that the fusible metal may be readily renewed without danger.

7. Efficient means, suitably located, shall be provided for cutting off all pressure from every part of a system as may be necessary to prevent danger.

8. Efficient means, suitably located, shall be provided for protecting from excess of current every part of a system as may be necessary to prevent danger.

11. Every motor, converter, and transformer shall be protected by efficient means, suitably placed and so connected that all pressure may thereby be cut off therefrom and from any apparatus in connection therewith, provided, however, that where one point of the system is connected to earth there shall be no obligation to disconnect on that side of the system which is connected to earth.

12. Every electrical motor shall be controlled by an efficient switch or switches for starting and stopping, so placed as to be easily worked by the person in charge of the motor. To prevent danger through the automatic restarting of a motor, every electrical motor or group of electrical motors shall be protected by a release which will automatically break the circuit if the current is interrupted; such release being suitably placed with regard to the danger to be prevented, provided that no release shall be required for any motor which has an attendant constantly at the controller of such motor while at work. In every place in which machinery is being driven by any electric motor, there shall be means at hand for either switching off the motor or stopping the machinery.

13. Every flexible wire for portable apparatus shall be connected in a system either by efficient permanent joints or connections, or by a properly constructed connector. Adequate precautions shall be taken

against shock due to leakage or other cause in all places where the person handling the portable apparatus is not insulated from earth. In such places and where the pressure exceeds low pressure, the portable apparatus and its flexible wire shall be controlled by sufficient means suitably located, and capable of cutting off the pressure.

19. All parts of generators, motors, transformers or other similar apparatus, at high pressure, or extra high pressure, and within reach from any position in which a person employed may require to be, shall be, so far as reasonably practicable, so protected as to prevent danger.

20. Where a high pressure or extra high pressure supply is transformed for use at a lower pressure, suitable provision shall be made to guard against danger by reason of the lower-pressure system becoming accidentally charged above its normal pressure by leakage or contact from the higher-pressure system.

Now the Commissioner's report is being awaited with the keenest curiosity by the purveyors of electricity, who would like to believe that their commodity is, in accordance with their advertisements, the safest existing means of lighting, heating, and driving.

TWO LEGAL DECISIONS.

The Modern Nuisances of Life—Municipal Traders' Contracts.

THERE have been a couple of cases in the Courts recently that are of general interest to those carrying on industrial works, and especially to suppliers of electricity and gas. The first one to which reference may be made is that of *Heath and Others v. Brighton Corporation*. Electricity generating-stations have frequently been involved in actions-at-law on account of nuisance to neighbours. In this instance, plaintiffs sought an injunction to restrain the defendants from working their machinery at the North Road generating-station in such a manner as to cause a nuisance to the worshippers in the church of St. Mary and St. Mary Magdalene, Brighton. While people are at their devotions, a perpetual hum or buzz must be very irritating; or while a preacher is engaged in his discourse, such a noise must be disconcerting. In this case, there was no doubt some ground for complaint. Imagination is accountable in life for a great deal; but it alone can hardly conceive a nuisance and continue to support it over a lengthened period as an actuality, when there is no real existence. The very act of the Corporation having taken steps to bring about improvements to abate the nuisance complained of, is an indication of their recognition that nuisance did exist. Improvements notwithstanding, the plaintiffs maintained that the trouble was a continuing one, and interfered with the conduct of public worship. The evidence laid before Mr. Justice Joyce was conflicting as to the volume of the noise. Plaintiffs described it as an unpleasant or buzzing noise; while defendants alleged it was a slight noise, rarely and barely audible. For the latter, too, it was asserted that the Corporation exercised their powers in the most reasonable manner, that the most modern type of machinery was used, and that it was housed in a building specially designed for the purpose. A number of experts had busied themselves in the matter. They had been specially to the church and to the generating-station; and their testimony was rather favourable to the view that the nuisance was not of the magnitude that the plaintiffs alleged. The experts included Professor Wilson, Professor Boys, Mr. James Swinburne, and Mr. Arthur Wright; and from their observations, specially directed to detection if there was anything to detect, they did occasionally discern a low hum or buzz, such as might get on to the nerves of sensitive people and be exaggerated by them. The upshot was, and this is the interesting point for industrial establishments containing running machinery, that his Lordship, after a long hearing, came to the conclusion that the plaintiffs were not, because their premises were used as a place of worship, entitled to anything more than the ordinary amount of quiet to be obtained in a town. There is no definite legal rule or measure as to what amount of noise, or annoyance from noise, is sufficient to maintain an action; and his Lordship put the position in this way so far as this case was concerned. The sound might at times cause anoyance or irritation to certain sensitive persons, but it ought not to distract the attention of any ordinary healthy persons. The law does not regard trifling inconveniences; and things of this sort must be looked at from a reasonable point of view. There might be considerable annoyance, and yet not a legal nuisance sufficient to support an action. His Lordship thought that the granting of an injunction would be a serious matter in this case. On the whole, his Lordship considered the plaintiffs had not established their right to relief. In other words, the law says that people must not let their nerves get the better of them, but that they must brace them up to cope with whatever shocks or annoyances, within reason, may be caused by modern conveniences.

Damages for breach of contract were obtained in a case in which Messrs. Bourne and Hollingsworth and the Marylebone Council were concerned as plaintiffs and defendants. The main ground of action does not greatly concern us here; but one point in the defence raised the question of principle as to whether any distinction really exists between an ordinary trading body and a municipal authority engaging in trade, which distinction specially favours the latter. The plaintiffs made a claim in respect of breach of contract, established partly in writing and partly verbally, to supply by a certain date electricity at a voltage of 240 to their new premises in Berners Street. For the defendants it was denied that contracts were made, or that the persons making them had any authority from defendants to enter into them. A further submission was that, if the contracts were entered into, they were not made under the seal of the Council, and were therefore not binding on them; also that the alleged contracts were not made within the power or capacity of defendants, and were therefore void. If, however, there was any liability, it was contended that it could only be a penalty not exceeding 40s. per day, recoverable in a Court of Summary Jurisdiction. The findings of the special jury were in favour of the plaintiffs, and judgment was entered for them for damages agreed at £500; but a stay of execution was granted by consent. These broadly and briefly are the facts of the case; but there is the general, and interesting question as to the fixing of the common seal of the Council being an essential in a contract in connection with their trading enterprises, and whether in this respect there is a distinction in favour of Municipal Corporations in contrast with an ordinary trading body. There is precedent in legal decisions to the effect that, under the circumstances, the seal is not an essential, and that there is not the suggested distinction. It would be monstrous if, in the case of a contract from which benefit arises to both parties, a dispute should place the one in a favoured legal position by any—perhaps designed—neglect to affix a seal. In the case of *Lawford v. Billericay Rural District Council*, 1903, Lord Denman, in the Court of Appeal, said:

> To enforce an executory contract against a corporation it might be necessary to show that it was by deed; but where the corporation have acted as upon an executed contract it is to be presumed against them that everything has been done that was necessary to make it a binding contract upon both parties, they having had all the advantage they would have had if the contract had been regularly made. This is by no means inconsistent with the rule that, in general, a corporation can only contract by deed; it is merely raising a presumption against them from their acts that they have contracted in such a manner as to be binding upon them, whether by deed or otherwise.

In the Marylebone case, Mr. Justice Ridley, referring to this decision, said if a corporation was there presumed to have done everything that was necessary to make the contract a binding one on both parties, because they had had all the advantage which they would have had if the contract had been regularly made, why should that not be so in the present case also? He also alluded to a judgment by Lord Chief Justice Coleridge in which these remarks appear:

> The question is whether the contract required a seal. There is, no doubt, a distinction between trading and other corporations; but I can find no authority for the position that a municipal corporation, when engaged in any trading transaction, is to have the same immunity as a corporation created under an Act of Parliament for the very purpose of trading. I treat this case as that of a municipal corporation, and one to which the exception in favour of trading corporations is applicable.

Mr. Justice Ridley thought that in these remarks Lord Coleridge was dealing with a municipal corporation which had no statutory power to trade. But, he added, "if a municipal corporation receives statutory powers to trade, does it not become a trading corporation for the purposes for which these powers are given? I cannot distinguish for this purpose between a corporation created for the purposes of trade and a corporation to which statutory powers are granted; and, therefore, I think that defendants' point as the seal fails." The point is worth particularly noting in these days of widespread and extending municipal trading.

The Municipal Exhibition.—In the "JOURNAL" for the 7th inst. (p. 20), reference was made to this exhibition, which will be held in the Royal Agricultural Hall, Islington, from the 1st to the 12th prox. We learn that during this period conferences will be held on questions of special interest to municipal engineers and surveyors; and that, in addition to the demonstrations and experiments in lighting previously alluded to, the subject of water supply will be dealt with by Mr. J. G. O'Sullivan; while Mr. Noble Twelvetrees will discourse on the use of reinforced concrete in municipal engineering.

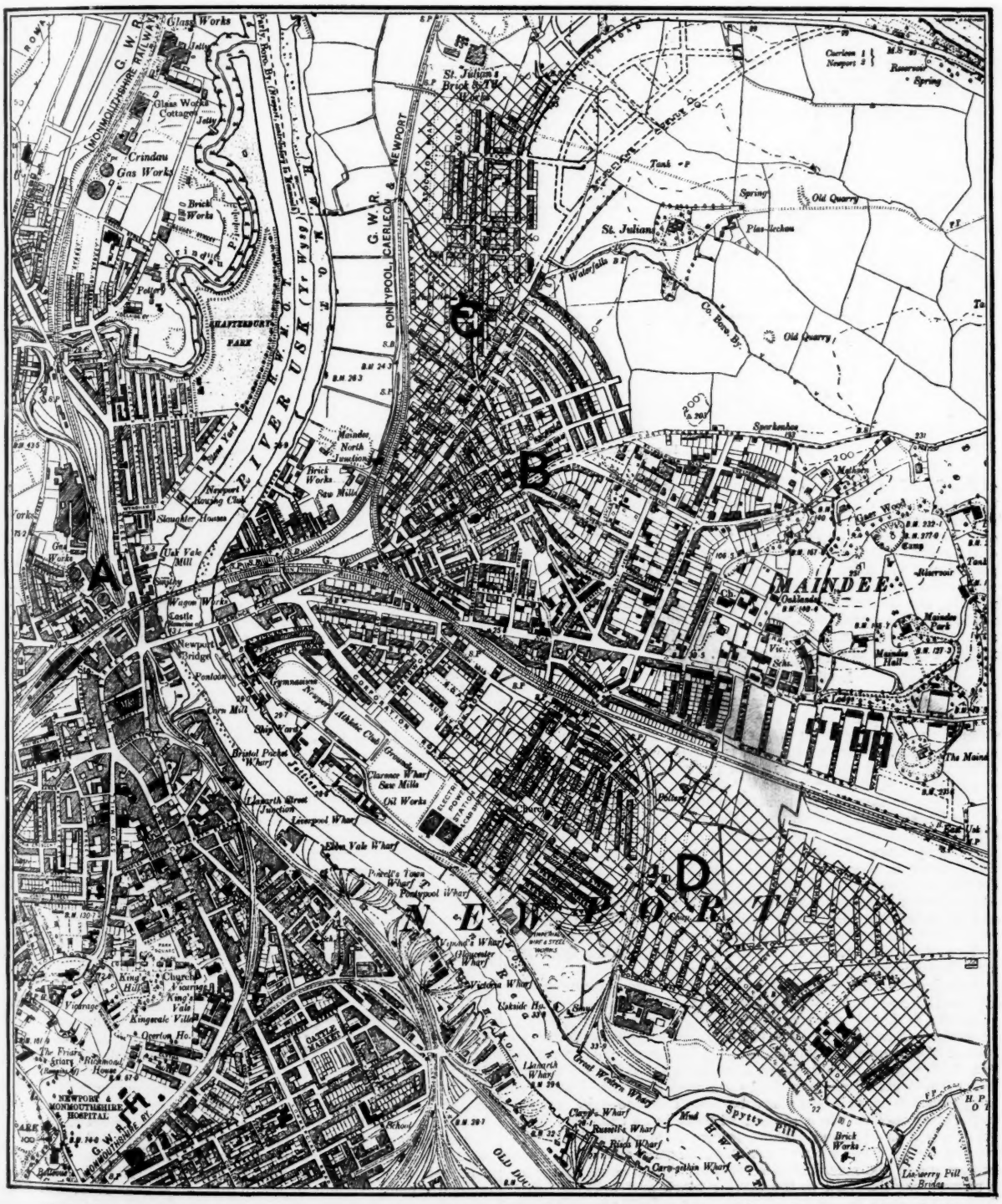
"Transactions" of the Institution of Gas Engineers.—We have received the "Transactions" of the Institution of Gas Engineers for the past year. It contains the papers, illustrated by a number of plates and diagrams, submitted to the members at the annual meeting held in Dublin last June, under the presidency of Mr. Charles Hunt, M.Inst.C.E., with reports of the discussions upon them, and a record of the general proceedings. The volume is more bulky than usual, owing to the inclusion of the report, reproduced from the "JOURNAL," of the proceedings at the second session of the International Committee on Photometry, held at Zurich from the 18th to the 20th of July. In a circular signed by the Secretary to the Institution (Mr. Walter T. Dunn, F.C.I.S.), which accompanies the volume, it is explained that the preparation of this additional matter and the catalogue of books contained in the library caused a delay in the publication. The contents include, as usual, notices of the members removed by death during the year, abstracts of papers which have appeared in the "JOURNAL" and a few other technical publications, lists of office-bearers and members, &c.; and they are preceded by a well-executed portrait of the President bearing his autograph, as a frontispiece. The volume has been produced under the editorship of Mr. Dunn.

HIGH-PRESSURE GAS DISTRIBUTION AT NEWPORT, MON.

By Thomas Canning, Assoc.M.Inst.C.E., Engineer of the Newport Gas Company.

The wide, navigable River Usk divides the County Borough of Newport into two unequal portions. On the western side or right bank of the river, is situated the main portion of the town, the municipal buildings, the docks, gas-works, railway stations, wharves, and principal shops. The part of the town on the eastern side or left bank of the river is a new development which has grown up rapidly within the past fifteen years, which is still extending, and is likely to extend at a much more rapid rate in the future. The lands in the neighbourhood of the river on this side are flat and low-lying—extending out to the mouth of the river; while behind them rises the wooded hill of Christchurch and other elevated tracts constituting a very pleasant residential quarter. The low-lying lands, however, are covered with works, small shops, and a throng of streets with houses for the artisan and the working classes. The prepayment meter system is very largely developed in this district, as it is in all the working-class districts of Newport. There is consequently during the hours of cooking in the daytime, and during the hours of lighting at night-time, a big demand for a supply of gas. There are two portions of these low-lying districts which are very considerably below the general level of the entire district—scored on the map here given and marked "C" and "D." To supply these districts adequately, it was found that a separate supply became an absolute necessity, as it would be intolerable to raise the ordinary pressure of the district to such a height as would enable consumers in these localities to obtain an adequate supply of gas during the heavy hours of consumption.

The river it will be seen forms a great severance between the gas-works and these places; and with respect to the bridges, there are difficulties to be overcome which there is no call to discuss here. It was therefore finally decided by the Directors



Part of Borough of Newport, Mon.—Showing: A. Gas Company's Compressing Station. B. Governor Pits. C, D. Low-Lying Districts Requiring Additional Pressure for Supply.

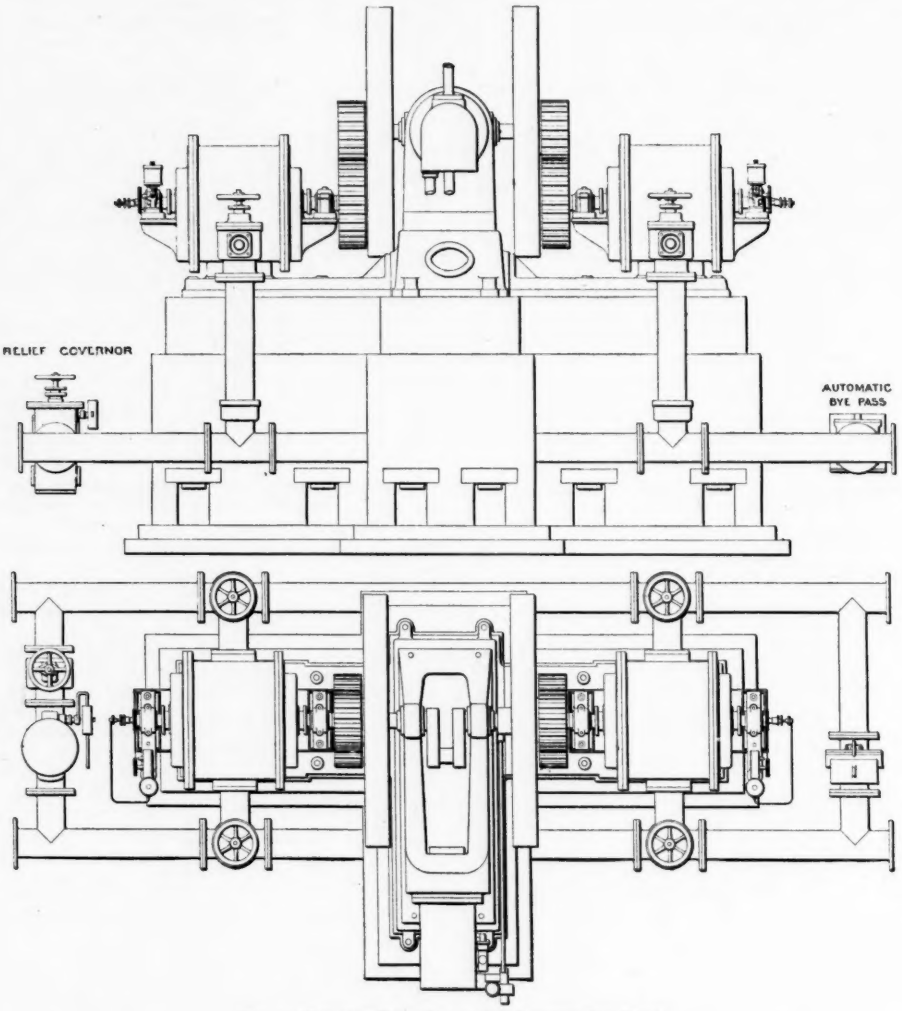


Fig. 1.—Plan and Elevation of the Compressing Plant.

of the Gas Company, on the advice of their Engineer, to adopt the high-pressure system of gas distribution, and to carry it out in such a way as would lead to its application in the future to the extensions in other populous and rising districts upon that side of the river. It now remains simply to describe the system employed, and which has been in operation since the month of May, 1907—that is, for a little under twelve months—without, up to the present, one single hitch, even of the slightest, taking place in the working. The satisfaction given to the consumers is, perhaps, after all the best test of the great success of this system; and its further extension is a question of time.

I.—Gas-Compressing Plant.

The general arrangement of the gas-compressing plant is shown in fig. 1. The plant consists of two rotary compressors driven through spur-gearing by a "National" gas-engine, which is placed between them. Each compressor is capable of pumping 15,000 cubic feet per hour against 10 lbs. per square inch. The gas-engine is the "C" size "National," and can develop 14·5 B.H.P. The design of the compressor is the patent of Mr. H. M. Hodson, of the Bryan Donkin Company. Externally it resembles an ordinary gas-exhauster. An exhauster, however, is only suitable for working against moderate pressures, because the driving member, which is the axle or drum, has to be made of cast iron. In this compressor a steel shaft supported in bearings at each end has a driving block keyed on to it; and this shaft and block drive round the slides of the compressor while the cast-iron drum rotates without exerting any driving force. In this way, a very much stiffer and stronger design of machine is secured, which is specially suitable for working against high-pressures.

In order to secure efficient working against these pressures, the slip must be reduced to a minimum. To obtain this result the slides are designed with very broad ends, so that a large amount of surface is in contact with the end plate, as the slide moves round. Consequently, the oil present in the machine forms a practically gas-tight joint between the slides and the end plates. The nose-strips or packing-pieces are also of a new design, by which surface-contact is ensured between the nose-strip and the cylinder or shell of the machine; whereas in an exhauster, only line-contact is obtained. These improvements, combined with careful fitting, have secured a high volumetric efficiency. The lubrication of the machines is automatic; the oil being forced by a pump along the shaft to the driving block and working faces. The compressors are arranged so that one or both machines may be run at a time. The spur gearing gives a reduction of 3 to 2 between the gas-engine and the compressors.

Referring to fig. 1, the arrangements for bye-passing and governing are as follows: In case the compressors should stop, an automatic valve is provided, which will open so that a supply of gas under the holder pressure would still be available. To maintain the required pressure constant on the outlet of the compressors, a special relief-governor is provided. As the compressors are driven by a gas-engine, they run at a constant speed; and this valve bye-passes any excess of gas pumped.

When, therefore, the plant is started, if no gas is required at the distant end of the high-pressure main, this valve is full open, and bye-passes the compressors completely; and it gradually closes as the demand for gas comes on. As already stated, the motor at Newport is a gas-engine, but in the case of the compressors being driven by a steam-engine, a special governor would be needed to regulate the speed of the engine according to the demand for gas.

II.—High-Pressure Gas-Main.

The high-pressure main consists of Mannesmann steel tubes jointed in the ordinary way, except across the bridge; the specially prepared jute covering which is upon all these pipes being added, to cover the joints themselves, by the Company's men in laying. Owing to the construction of the bridge, short lengths had to be employed; and to provide against vibration, the Engineer had these pipes screw-jointed. As the mains progressed, special care was taken to have them heavily tested before filling in. It was not considered necessary to put in more syphons than would have been the case in an ordinary main; but it is necessary to pump them oftener.

In the compressor room a large dial pressure-gauge is fixed, showing the initial pressure maintained in the high-pressure main. As this gauge, however, was found not to be of sufficient accuracy, a mercurial gauge of special construction was designed by Mr. J. H. Canning, and constructed by the well-known scientific instrument maker, Mr. J. J. Hicks. For the purpose of ascertaining and recording in the compressor room the actual pressure of the gas after it has been transformed to the required district pressure, there is a return pipe laid in a trough filled with bitumen. It was laid at the same time as the main; and to it are attached the requisite gauges and recorder. There is also telephonic communication between the compressor room and the governor pits.

III.—Governors and Governor Pits.

At the far end of the high-pressure main are fixed the district governors for reducing the high pressure to that required on the district. The governors used are of the Reynolds high-pressure district type, for which the Bryan Donkin Company are the European Agents. These governors were described at length in the "JOURNAL" for June 25, 1907, in the report of Mr. Searle's paper read before the Institution of Gas Engineers at the Dublin meeting. They are arranged, in duplicate, in two pits side by side. The arrangement of the governors in the pits is shown in elevation in fig. 2, and in plan in fig. 3. These pits are built

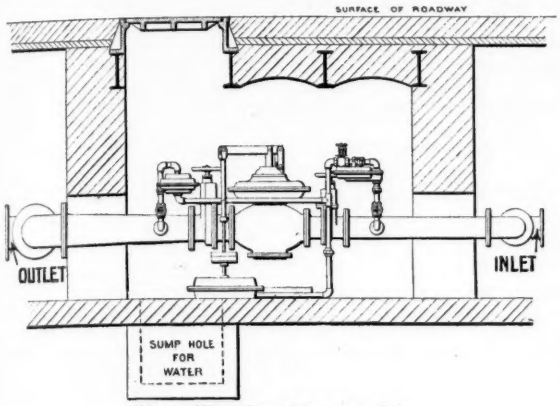


Fig. 2—Elevation of Governor Pits.

underneath the roadway, at the junction of three roads; and they are large enough for two men to go down into each pit, so that the governors can be examined and oiled at any time with ease. A manhole cover is fitted to each pit; and a sumphole is provided, into which any water getting into the pit can drain.

In addition to the telephone from the governor pits to the works, there is an electric pressure-alarm attached to the outlet of the governors. If, therefore, the pressure exceeded a given limit, the alarm would ring a bell in the compressor room at the gas-works.

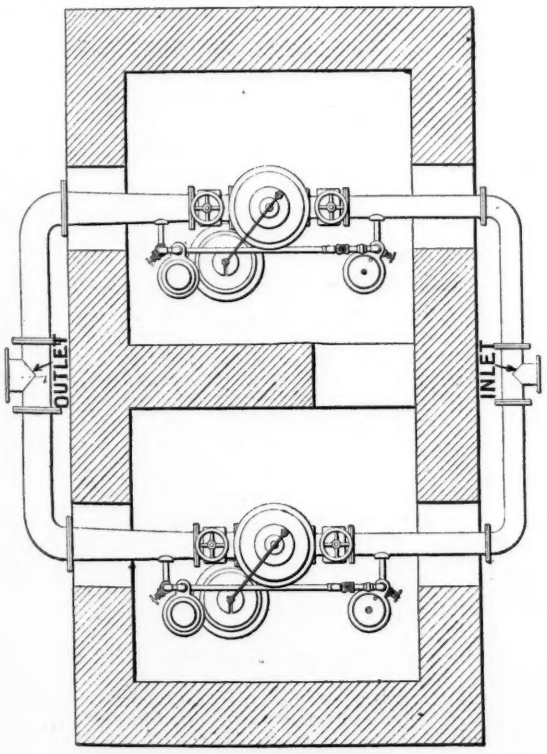


Fig. 3—Plan of Governor Pits.

The Reynolds governors are of the diaphragm type; so there are no water seals that can blow in the event of excessive pressure. These governors are largely in use in the United States, and are entirely relied upon for admitting the high-pressure gas into the mains. The special feature of these governors is that, by means of the auxiliary apparatus, they maintain absolutely constant pressure in the service mains, however the demand for gas may fluctuate, and however small it may become.

Hitherto, in all governors used for this purpose, it has been found that when the demand for gas became very small, the governor did not shut off the high pressure to the required exact extent, with the result that the pressure gradually leaked past the governor, and ultimately caused excessive pressure in the service mains. In the Reynolds governor this defect is quite overcome by the auxiliary apparatus, which is an arrangement of supplementary governors which deals with small quantities of gas during times of minimum consumption—the main governor during such period being absolutely shut. When, however, the consumption of gas increases beyond the capacity of the auxiliary apparatus, the main governor automatically comes into action. Conversely, when the consumption is becoming very small, additional pressure, by means of the auxiliary apparatus, is exerted to close the main governor by means of the auxiliary bowl. In this way, the main governor is closed with great certainty, and absolute uniformity of pressure on the outlet has been secured during the nine months' working at Newport—which period included the heavy winter demand.

In order to prove the tightness of these governors, the following severe test was made before the outlet mains were connected on to the district. With 3 lbs. pressure on the inlet side, the governor was adjusted to carry 4 inches of pressure on the outlet. The compressing plant being at work, the governors delivered the air pumped into the atmosphere through the open end of the outlet main. A valve on the outlet main a few feet away from the governor was then shut down, when it was found that a pressure-gauge fixed between this valve and the governor kept absolutely steady at 4 inches (the pressure to which the governors were set), with 3 lbs. pressure on the inlet, and with no air passing. This test was much more severe than would occur in practice, because the system of service mains on the outlet would have an appreciable capacity even if the demand for gas was absolutely *nil*, whereas by shutting down the valve mentioned the slightest leakage would at once have become evident.

IV.—Safety Mercury Seal.

In order to render it quite impossible for the pressure in the district to rise above a given limit, a safety mercury seal was provided. This is fixed in the base of a lamp-column (see fig. 4)

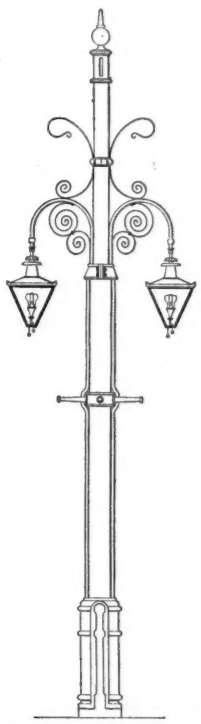


Fig. 4—Ventilating Column, used also as a Lamp Column.

near to the governor pits, and is connected to the outlet main from the governors. In the event of the seal blowing, the gas would escape in safety at the top of the lamp-column. The seal-pot is so designed that the mercury will run back and form a seal again automatically as soon as the pressure falls below the given limit. It is interesting to note that this installation is the first in Europe in which Reynolds district governors have been used.

V.—Method of Operating.

The plant is run twice a day—during the cooking hours of the morning and during the evening. The compressors are started about a quarter-of-an-hour before the period of heavy consumption begins; and as little additional gas is required at first in the district, the bye-pass valve is fully open. When starting, it is not necessary to send out to the governor pits; all valves are left open, and the governor automatically comes into action as soon as the pressure on the outlet reaches the amount to which the governor is weighted. As the consumption of gas increases, the Reynolds governor opens out, and as a consequence the bye-pass governor at the compressors gradually closes. When the end of the heavy demand period approaches, the reverse action happens;

the bye-pass valve at the compressors gradually opening so as to relieve the compressors. It is only necessary to send out to the governor pits when it is required to change the outlet pressure maintained by the governor, or to examine and oil the governors. This is done once a week, when the leather diaphragms are oiled to keep them in good condition.

VI.—Tests of Quantity of Gas Pumped and Loss of Pressure.

The following tests, made in May last, may be of interest as showing that, with the pressure used in the tests, Pole's formula gives results agreeing fairly well with those obtained in actual practice. The gas was measured by observing the fall of the holder from which the compressors drew their supply of gas. Of course, larger quantities of gas have since been pumped in actual working; but the initial pressure has not been materially increased. When the main is extended to a station further out, it will be well understood that the initial pressure will have to be brought higher.

Quantity Pumped. Cub. Ft. per Hour.	Main Diameter. Inches.	Length, in Yards.	Initial Pressure. Lbs. Sq. In.	Final Pressure. Lbs. Sq. In.	Loss of Pressure. Lbs. Sq. In.	Quantity by Pole's Formula.
18,900	5·00	1340	2·71	1·55	1·16	17,380
14,400	,,	,,	3·00	2·20	0·80	14,440
14,000	,,	,,	3·00	2·25	0·75	13,980
15,400	,,	,,	2·81	2·00	0·81	14,540

Specific gravity of gas, taken in Pole's formula, ·45.

An incidental, but by no means unimportant, advantage is the opportunity this system gives of regulating or diminishing the ordinary pressure of the district.

The compressing plant at Newport is now in use only for assisting a supply in the two districts described; but as it is capable of the further duty of supplying, independently, a whole district, it is at present under consideration to utilize it for this purpose, in the case of a village four miles from Newport.

THE APPLICATION OF MODERN COKE-OVENS TO THE MANUFACTURE OF GAS AND RESIDUALS.

[COMMUNICATED.]

THE consolidated object of the gas industry of to-day is to supply cheap fuel gas for lighting, heating, power, cooking, and general industrial use. To effect this, the *raison d'être* of their existence, gas engineers have of late given time and patient attention to the study of multifarious systems of carbonization advocated by eminent scientific men, and engineers of undoubted ability. Among the most important of these systems may be mentioned the vertical retort and the modern bye-product recovery coke-oven fitted with heat recuperators, trials of which have given much valuable information and have led to renewed exertions on the part of their advocates.

Most gas engineers controlling large gas-works have openly confessed to entertaining a great deal of admiration for recovery coke-ovens as an ideal labour-saving gas and residuals plant. But (and in this lies their hesitancy) the quantity of gas produced per ton of coal carbonized in the ovens, and the illuminating power—metallurgical coke-ovens considered—have not appealed to them as being sufficient to warrant the outlay for even an experimental plant, and, further, on account of the erroneous impression that the cost of coke-oven plant is greatly in excess of gas-retort plant for a given output of gas. This impression had, in the past, some foundation in fact; but this cannot now be held as valid of the latest type of coke-oven, which is nothing more complex than a "grown-up" retort. Its method of heating does not present any greater difficulty than the present-day settings of tens, twelves, or fifteens horizontal, inclines, or verticals. Its charge of from 6 to 12 tons can be carbonized in from 16 to 24 hours, with a yield of gas varying from 10,000 to 11,000 cubic feet per ton, having an illuminating power of from 14 to 16 candles and a calorific value of about 490 to 510 B.Th.U. net—depending, of course, upon the grade of coal carbonized.

The labour charges in connection with coke-ovens are well known to be low; and with a sloping coke-oven of the type illustrated, these charges will, it is hoped, show a further reduction equal to (say) 6d. per ton of coal carbonized. With existing metallurgical coke-ovens of modern construction, the yield of gas from a ton of coal is 10,000 cubic feet, and this with "Ras Las" coal having only 16·25 per cent. of volatile matter and 80·20 per cent. of fixed carbon—*vide* paper by Mr. E. M. Hann, M.Inst.C.E., on "Coking Small Coal," read before the South Wales Institute of Engineers, see Vol. XXV., of their "Proceedings." Having in view the fact that the coke-ovens giving this yield were designed for producing a metallurgical coke of the finest grade, it augurs well for a specially designed gas and coke oxen of the recuperator type with vertical flues heated bottom and top.

The results obtained by Mr. Hann, at Bargoed, with a good modern metallurgical recuperator oven are of sufficient importance to warrant attention to any modification of coke-ovens design to suit the requirements of a great industry having to supply gas of standard illuminating power and calorific value. Messrs. Krupp, the famous gunmakers of Essen, have just installed a battery of 150 coke-ovens, of the improved "Collin" type, for producing illuminating gas for flat-flame burners, and power gas for the various processes formerly utilizing solid fuel. A full description of these illuminating-gas ovens will be given by the writer at some future date.

The design now illustrated is on the inclined principle, and the tapering coking chambers are heated top and bottom by twelve sets of four gas-nozzles (= 48 burners in all), heating 25 vertical flues disposed alongside the oven. Then, in addition to the 26 vertical flues, there are 24 additional inter-vertical flues, down which the products of combustion pass on their way to the recuperator flues under the sole of the ovens. By means of a system of dampers electrically operated, simultaneously, it is possible to reverse the flow of the current of flame from the bottom to the top of the vertical flues or *vice versâ*; and this can be effected without reversing the main system of recuperators. The gas-ovens may be heated by their own debenzolized gas, of which 45 per cent. is required, or by "producer gas," just as circumstances dictate. By taking off a portion of the gas from the lower end of the oven, the "cracking" of the volatile hydrocarbon gases is prevented, and a better illuminating gas is obtained; and also freedom from naphthalene production. The coke from the gas-ovens is of a superior quality to the comparatively soft coke of the present-day gas-retort; and it has a greater monetary value, as will be found by experience. The yield of tar and ammonia products from the ovens will be greater than that obtained from the gas-retort, owing to the method of carbonizing being different. Tests in this direction are now in progress.

As regards the yield of gas, the distillation path is from the oven sides towards the vertical centre-line of the oven; and this action causes the gas to seek a passage up the vertical line from its point of liberation, and thereby escape (by a comparatively cool path) to the top of the oven and away to the outlets without undergoing that objectionable "cracking" which is due to the large percentage of non-contact radiant-heat surface prevalent in most gas-retorts.

Comparative figures are given in relation to bye-product coke-ovens and gas-retort plant for the benefit of those engineers who are ever on the alert for improvements and economy in their methods of manufacture.

A 21 inch by 15 inch ⏀ retort has a circular measurement of 5 ft. 1 in., and the retort is generally 20 feet in length. Therefore it has 20 ft. by 5 ft. 1 in.—viz., 101·66 sq. ft.; and taking for example a modern retort-setting of ten retorts per bed, we have $10 \times 101{\cdot}66$ sq. ft. of heating surface or, more properly speaking, carbonizing surface—viz., 1016·6 sq. ft. per bed of through retorts. Taking 10 ft. × 20 ft. as the actual space occupied per through setting of tens, we have 10 ft. × 20 ft. = 200 sq. ft. per bed.

The foregoing ten retorts (throughs) will, with 1016·6 sq. ft. of heating surface, carbonize 16 tons of coal per day of 24 hours—viz., 4 cwt. charges per mouthpiece. That is, $10 \times 4 \times 2 = 80 \times 4 = \frac{320}{20} = 16$ tons per day. Therefore $\frac{1016{\cdot}6}{16} = 63\frac{1}{2}$ sq. ft. of heating surface per ton per day.

With the modern recuperative coke-ovens we have the following interior dimensions of the coking chamber: Length 33 ft., height 7 ft. 6 in., width 20 in., giving a total of 605 sq. ft. of carbonizing surface. This, with an 8-ton charge, equals $75\frac{1}{2}$ sq. ft. per ton of coal per diem (24 hours).

Coal-gas retorts	$63\frac{1}{2}$ sq. ft. per ton-day
Coke-ovens	$75\frac{1}{2}$,, ,,

Modern Coke-Ovens.

A battery of thirty "Collin" coke-ovens requires about $98\frac{1}{2}$ feet by 33 feet area of land space; and taking each oven at 8 tons per day, we find we have $3250\frac{1}{2}$ sq. ft. of land, exclusive of charging and discharging floors in both instances, and this $3250\frac{1}{2}$ sq. ft. ÷ 240 tons of coal gives $13\frac{1}{2}$ sq. ft. of land per ton per day.

Retorts.

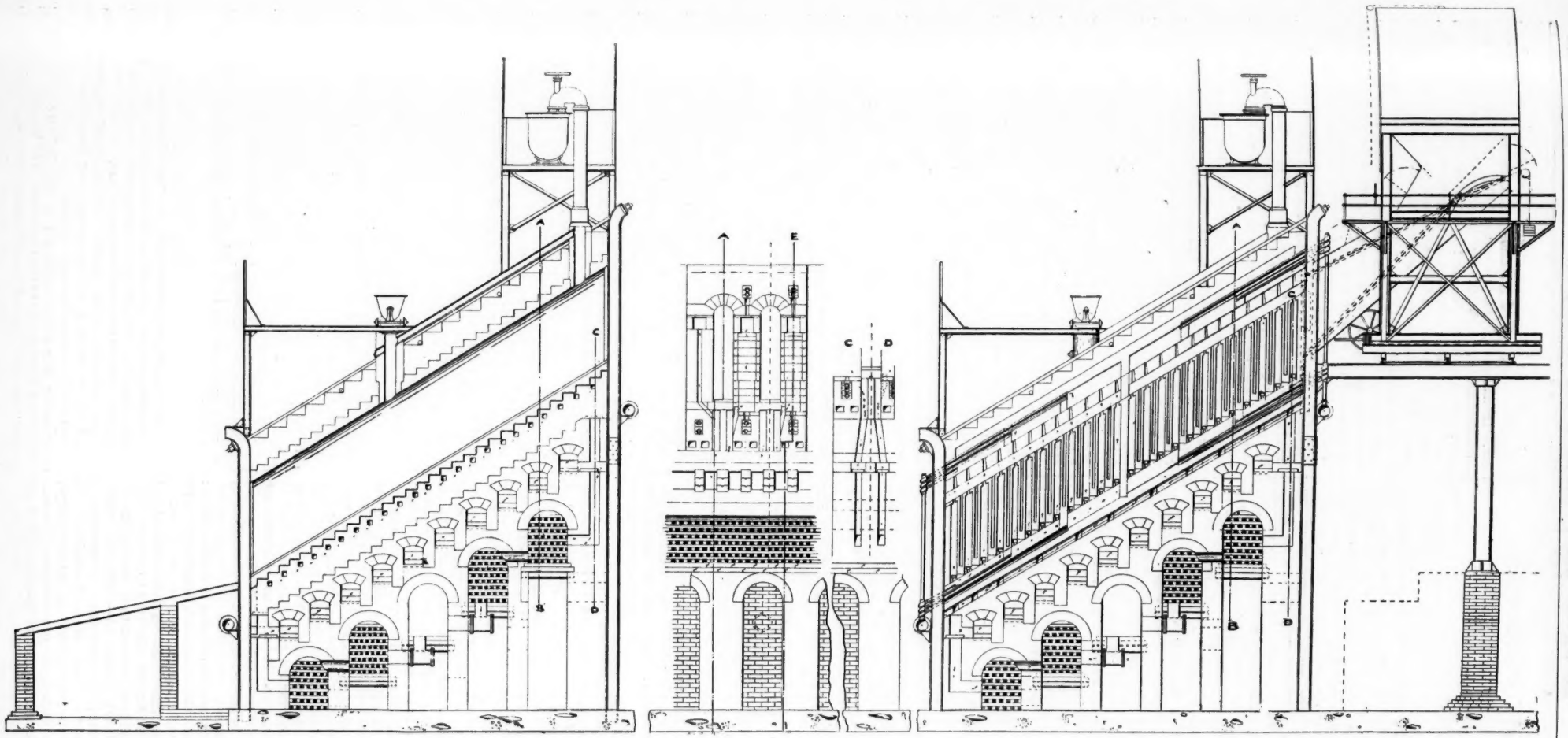
Taking ten beds of ten retorts each, with 10 feet centres, we have, for 20-feet throughs, a carbonizing capacity of 160 tons per day for an area of $10 \times 10 \times 20 = 2000 \div 160 = 12\frac{1}{2}$ sq. ft. per ton-day—viz., about 1 sq. ft. per ton less than coke-ovens.

Assuming the make of gas per ton for the retorts to equal 10,500 cubic feet, we have 1,680,000 cubic feet of gas per day per 24 hours.

Coke-Ovens.

The modern coke-ovens yield 10,250 cubic feet of gas per ton from rich Durham gas coal, and about 9000 cubic feet per ton from common, dirty slack. Taking good Durham coal in both cases for comparison, we have $240 \times 10{,}250 = 2{,}460{,}000$ cubic feet of gas per diem, of 24 hours, or 780,000 cubic feet greater yield per day, or about 45 per cent. more gas than from retort plant taking up the same amount of room.

For the structural cost per ton of coal carbonized per day, we find the following: A bench of ten retorts with everything complete except charging apparatus, coal-stores, foul main, &c., will amount to £50 per mouthpiece; and as each mouthpiece carbonizes



New Design of Sloping Coke Oven—Improved Collin Type.

16 cwt. of coal per diem, or 0·8 ton, we have £62 10s. per mouthpiece-ton for construction account, or for 200 mouthpieces £10,000 —viz., 10 × 10 × 2 = 200 mouthpieces × £50 = $\frac{£10,000}{160}$ = £62 10s. per ton per day.

With a battery of "Collin" ovens—say thirty complete, with the exception of the charging apparatus and discharging machine —the writer would estimate the cost per oven at approximately £400 × 30 = £12,000 ÷ 240 tons = £50 per ton-day. This is less than gas-retorts per ton of coal for structural cost. With a larger installation, the cost is reduced considerably.

CARBONIZING WAGES.—SLOPING COKE OVENS.

Wages, Coke-Ovens carbonizing 240 Tons per Day.

	s.	d.
Three charging men on 12-ton gravity slide-door hopper	15	0
Three assistants	12	0
Three winch men on lower doors	15	0
Three pipe-men cleaning pipes	15	0
Three luting men on automatic luter	12	0
Three quenching men on coke floor	12	0
Three men attending to gas-burners and motors	15	0
Three men doing general work on the discharge side	10	6
	£5	6 6

Or 5·3d. per ton of coal carbonized. With good modern gas plant and a Fiddes-Aldridge machine, the wages will amount to 8½d. per ton on a similar basis of work done.

It is hoped that the foregoing will be of some interest to engineers wrestling with the problem of "How to make cheap and good gas with a minimum of trouble and expense."

The authorities of the University of Cambridge have elected Lord Rayleigh, the Chief Gas Examiner for the Metropolis, as Chancellor, in succession to the late Duke of Devonshire.

NEW GAS-WORKS AT ARNSIDE.

By Thomas Redman.

(Part II.)

In picking up the strings of this narrative, let me revert to the primary cleanser, hereinafter referred to, for brevity, as the "P. C." This, as previously stated, is intended to strip the gas of its heavy crude impurities, tar in particular, with, of course, the safe arresting of that ghost of the gas-works—naphthalene. May I here remark that it is not intended to manufacture this nightmare at these works, notwithstanding that working with high heats is anticipated; for the whole arrangement of the retorts and the adjoining fittings is studiously planned to avoid it. It is desired that this should be known in order to obviate any misapprehension as to its satisfactory working in this particular channel in the future. The importance of a simple and cheap, but effective, apparatus for this highly essential duty to the crude gas at this stage of its manufacture cannot, in the designer's opinion, be very well over-estimated in value, because of the important functions that it should perform and the constancy of working the needs require. The designer has very carefully sought to attain these points in the simplest possible way, but always without sacrifice of efficiency. For instance, when it is realized that this watch-like miniature of a "P. C." will do more effective work as compared with a tower scrubber, which may be over 1000 times larger (as may be the case), and, as a gas, when it is realized that this miniature work-devouring apparatus—say, from 9-inch to 12-inch size—can be bye-passed, opened, its entire interior or working medium extracted and replaced by a clean set, re-closed, and put into full operation with comfort within the small space of ten minutes by one man, readers may readily conceive for themselves, in and under their own various individual circumstances, the enormous advantages of such an apparatus, as against the costly, dirty, irksome, and dangerous work of renewing the contents of a huge tower scrubber.

To enable this to be accomplished with such desirable dispatch, it will be readily seen that not a single joint in either the gas, steam, or tar pipes is necessary; nor the undoing of a single bolt. Otherwise, such expeditious handling would be impossible.

To put the comparison in another way, I do not think I am over-stating the case by dealing with it as follows:

Cost of Time, Labour, and Materials for (say) a 12-Inch Pipe Size in Each Case.

Primary Cleanser.	s.	d.	Tower Scrubber.	£	s.	d.
Time, 10 minutes—			12 days—			
Labour, 1 man . . .	0	6	3 men, at 4s. each	7	4	0
Renewal materials (full set)	5	0	£10 to £15 (say) .	12	10	0
	5	6		£19	14	0

Now let us say, for safety's sake—not that I believe that more than twice will be needful—that the "P.C." requires three renewals to one for the tower scrubber. Thus we get the cost of the "P.C." at 16s. 6d., against £19 14s. for the tower scrubber over a like period. The economy attached to the former, as shown, might easily be extended.

Prime Costs and Space Occupied.—These are important items when on the table for serious consideration in the programme of costs in £ *s. d.* and facility and accommodation. Taking them in this order, it will, I have no doubt, already have been recognized that the difference in prime costs will be very marked—say, with safety, as 1 to 10 or more; while the comparison as to space or facility is even wider than the prime costs of the respective apparatus, for the "P.C.'s" may generally be planned in the foul main, without a thought for a single extra square yard of ground. This cannot be said in respect to the tower scrubber, notwithstanding its small ground area to its bulkiness upwards. I am quite aware that there are various other appliances employed in this work besides the tower scrubber, and also that the latter is not always primarily intended as a tar-extractor. I am also aware, and firmly convinced, that were it possible to entirely strip the crude gas of its tar at this early stage in its manufacture on its way to, and before it strikes, the first and future apparatus for the various further purifications, all such apparatus and operations, with the freedom from tar, would at all times be infinitely more effective, and proportionately so with any reduction of the objectionable ingredient and impediment at all further stages of purification. Therefore, the entire success of this simple little economical apparatus may be assigned to the following points: (1) The effective working is secured by the reversal of the flow of gas through the apparatus at suitable periods of time; (2) its great facility and quick dispatch for attendance; (3) its extremely low working cost and up-keep.

Before parting from this particular apparatus, of such various great economies, I would remark that, with the ever-increasing demands for cheaper gas—be it competition with other agencies, or in the race for production on a given area—the cost for treatment, returns on residuals, and the general trend of the times for a cheaper and perhaps a more useful gas, must eventually be successfully met very largely by remodelling and the adoption of improved apparatus and methods in the production and general manipulation of the gas from the source of its evolving to the consumers' meters.

Miscellaneous.—I propose, now, to increase the warp of this narrative by inserting a few odds and ends not mentioned thus far. In doing so, I must perforce touch upon some that have already received attention; but let us go to the arrival of the coal. The gas-works are most favourably situated in respect to this important item; for alongside the works is a railway siding. The waggons are emptied direct from a position on the siding to the works, or, to be more correct, into a steel-frame concrete coal-storage tower. This is another departure from the ordinary methods and lines adopted in dealing with this bulky commodity within the works, as here a storage of over 30 tons is accomplished on a ground space of 10 feet by 7 feet, or equivalent to the floor space covered in the retort-house with two cart loads, or two tons, when nicely squared up. The coal, however, in this case never sees or touches the retort-house floor, but is elevated to a fixed storage gravitating charging hopper close to the roof. From this hopper the coal is fed into a travelling hopper, which will contain a full charge for one retort, and is so arranged that it serves all the retorts.

A simple arrangement in connection with the suspending of this travelling charging hopper enables the charges to be weighed when required, or desired, for testing purposes or otherwise. Having brought the coal in the charging hopper to the retort, the discharging is accomplished in somewhere about half-a-minute, and without the least need for wiping or dashing away the blinding perspiration from the operator's brow. The whole work in the operation is as follows: The travelling charging hopper is placed into position over the feeding shaft; a tapered guiding bucket being placed between the mouthpiece and the hopper. It is then ready for charging. But we must first discharge the retort. For clearness of understanding, I think it best to follow the cycle of working. The attendant descends from the top of the retort-bench to the gangway, formed by the extension of the furnace in front of the benches, and widened over the furnace-doors by a steel extension supported from the buckstays. For the easy handling of the rather bulky retort lids and stoppers, a runner is provided and fixed to the double H-steel girder buckstays at a convenient height. Upon this the heavy doors are suspended and travelled to and from the luting station. Although so bulky, they are far more easily handled by this means than ordinary medium-sized loose retort-lids of light sheet steel; for the bar travelling rail and trolley takes the work—the attendant, in a sense, merely conducts. Higher up and further extended, and on a level with the top of a high retort-house door, is another runway of stronger dimensions, which is supported within the house by steel brackets attached to the buckstays. On this is arranged, in lieu of hand coke-barrows, a coke skip, suspended to a trolley for easy travelling to and from the coke yard.

Let us now return to the discharging of the retort. The coke-skip or skeleton hopper is in position in front of the retort; the lid is removed, and then the stopper; and out slides the block of coke carbonized from the 6 cwt. of coal. To handle this quantity by the ordinary method of hand barrows would be out of the question with the state of labour nowadays; but on this arrangement it is quite an easy matter. It is travelled into the coke yard, and, while still suspended, undergoes its quenching. This is not done by buckets or hose pipe, but by pulling a knob in connection with a chain and a large flushing cistern and sprays suitably arranged. While this is proceeding, the attendant is back replacing the stopper and putting on the fresh luted lid, which was standing hard-by in readiness. The operator then returns to the top of the bench to charge the retort with the coal just previously left in position for this object. It is often remarked after the accomplishment of many of these operations: "Oh, how simple; how very simple and easy." I contend that, compared with shovel charging, in both senses in this case, it is the essence of simplicity and ease.

The first act is to move a long slide-valve at the top of the retort, which provides an opening about the size of an ordinary brick, flat way. The coal, having been previously let down from the travelling hopper into the tapered guide bucket, is retained there by a light sheet-steel slide, which is now withdrawn. This sets free the coal, which slides into the retort in double-quick time. The long slide valve is at once replaced, and then the light steel coal-stop slide; and all is over in respect to the discharging and charging of this unit for the next twelve to fifteen hours—the coal conveying and feeding hopper being at liberty for the next retort. For the purpose of conveying a clearer view of the cycle of the above operation, I have avoided mentioning one other little act in connection with this working—*i.e.*, sealing and unsealing. This is done by moving the handle of the hydraulic valve between two stop-limits of about 90°.

Now let us return to the coke yard, where we find the coke in the skip. Its discharge is required; and to do this, no effort is necessary to tip it. All that is required is to insert a small lever, give it one sharp jerk, and two hinged flap-doors drop out at the bottom—thus setting free the coke. These are afterwards refixed, and the coke-hopper is ready for the next discharge. The top of the coal-storage tower forms an advantageous position, and is used for a large water storage tank.

Tar.—In consequence of the long-continued unremunerative state of the market for this article (and especially is it so for small works, where the price realized often lands its disposal on the wrong side of the ledger), I as the designer of the retorts have had other ideas for its more profitable disposal. With this object, provision is made for the return of the tars to the retorts;

but I do not think that this identical method will be the best that can be, nor anything like the last word on this most interesting subject to the gas industry; for whoever expects to reach perfection and finality in one stride or effort without subjecting himself to great disappointment? *Vide*, Herr Körting's splendid article on comparisons in the "JOURNAL" for Jan. 14 last, and the Editorial note in the following issue.

For the further carrying out of this object to a useful conclusion, a deep tar-separator is another rather special item in the plant at these works; and tar of various grades of gravity may be obtained and tested. I have previously stated that it is not intended to manufacture naphthalene; but in close touch with this part of my subject is the result of Herr Körting's report, and the comparisons given by him, in Table No. 6 in the article just referred to, as to the working results in the quantity and quality of gas evolved from 5-metre and 4-metre vertical retorts. The drop in candle power and calorific power, to my mind, is an object-lesson of considerable value and aid in focussing this subject; and it would be most interesting to learn to what extent tar suffered in quantity and quality, and likewise ammonia. Further, was the heavy loss in candle power the result of the volume of rich gas from the larger volume of coal in the lower portion of the retort passing through the fully carbonized coke in the narrow bottle-like neck of the retort and aggravated by its 25 per cent. extension? Then there is the question of reduced tar and ammonia, together with their undoubted deterioration in their qualities by the action of increased baking, while filtering through the extra length of the retort and its highly incandescent coke, and the extent that naphthalene increased or was created thereby.

Just one more question on this interesting topic before I leave Herr Körting's really valuable pictures and revert to the miniature combination retorts fitted at Arnside. I am vainly trying to picture for myself the state and quality of the coke at the various stages of 1 to 5 metre lengths when discharged, and more particularly in respect to the capacious bottom, or first-metre length, with the greatly contracted top and last-metre length, and the vastly different conditions under which they work—and, of course, the respective cokes contained therein—are subject to during the process of carbonization. Surely there is a marked difference in the two extremes; and, in all probability, some lesson or knowledge could be gained from close observation. Beyond remarking that the increase in volume is satisfactory, I have nothing further to say at present. For comparison, if the difference in quality of the gas between 4 and 5 metre length retorts is really so marked as shown in Table No. 6 of Herr Körting's article, what quality would be evolved by taking the gas directly or immediately above the first metre, or from a retort 1-metre long and of like dimensions as in the case of the verticals under consideration (for this, with a margin of increase, will represent the inclined carbonizing portion of the retorts at Arnside)? According to a purely theoretical survey and judgment on the preceding comparisons, observations, and remarks, the gas should be very rich in candle and calorific power, but low in volume; but the latter is not the result the designer anticipates.

(*To be concluded next week.*)

OBITUARY.

Mr. JOHN SIM, Provost of the burgh of Kinghorn, Fife, Managing-Director and Manager of the Kinghorn Gas Company, died at his residence there on Wednesday last. Deceased was a native of Kirkcaldy. He was a very active man in many ways in the public life of his adopted town.

Ex-Provost GLOVER, of Dumfries, died there on Monday evening last week, at the age of fifty-five. He had been Provost of the burgh for upwards of twelve years, and resigned only last month, on account of ill-health. Provost Glover excelled as a business man, and he was, in addition, a fluent and convincing speaker. For some years immediately before his retirement he was Convener of the Gas Committee of the Corporation.

The Mines (Eight Hours) Bill.—In reply to a question put to him by Mr. D. A. Thomas, the Member for Merthyr Tydfil, as to the date proposed for the Mines (Eight Hours) Bill to come into operation, Mr. Gladstone gave the following answer, which was among the printed replies in the Parliamentary Papers issued last Wednesday: "I have decided to propose an amendment to the Bill relating to the date of its operation, so as to provide that, in any event, no change shall be effected by it until after June 30, 1909."

Bursary for the Junior Institution of Engineers.—We learn that, through the munificence of Mrs. F. R. Durham, a bursary of the value of £25 per annum, to be called, after the Chairman of the Institution, the Durham Bursary, is about to be announced to the members and associates of the Junior Institution of Engineers, of whom those between the ages of twenty and twenty-two will be eligible to compete by writing a thesis on some technical subject chosen by the candidate. The first award will be made in October, and competing theses must be in the hands of the Secretary (Mr. Walter T. Dunn), at No. 39, Victoria Street, S.W., not later than the 1st of September next.

ADVICE TO ENGINEERING STUDENTS.

THERE was encouragement and sound advice for the present and the future in an extempore address that Sir George Livesey delivered last Tuesday to the students of the Crystal Palace Company's School of Engineering, which is under the direction of Mr. J. W. Wilson (the Principal) and Mr. Maurice Wilson (the Vice-Principal). It was certificate day; and there was a large gathering of students, parents, and friends, among the last-named being Mr. Charles Carpenter and Mr. S. Y. Shoubridge. Just before Sir George spoke, the reports of the examiners that were read told of the achievements of the students, and bore independent witness as to their high efficiency in their work, and as to the excellence of the training they receive, both theoretically and practically. The reports Sir George, as the invited distributor of the certificates that day, a little later truly described as being of a character of which everyone might be proud. The formalities of the occasion do not concern us. He had been over the shops and the drawing-office, and had seen specimens of the work done. He said that the work showed not merely very considerable engineering ability, but it disclosed to him a high personal quality—that quality which makes for useful work all over the world, the quality of devotion to duty, and of putting one's heart into that which one finds to do. Later on, he spoke of the craze in these days for labour-saving appliances. Any contrivance, he remarked, that can be invented whereby labour can be saved is thought to be good. What does this mean? It means that a vast number of men are thrown out of employment. There are contrivances for lighting and extinguishing street gas-lamps by mechanical means. The Gas Company supplying the Crystal Palace district were asked by a Borough Council what difference it would make in cost if these things were adopted. The Company's reply was that it would not save much; the greater part of the saving being due to the much shorter hours the lamps would be alight by lighting them after dark and extinguishing them long (1¾ hours) before sunrise. But, on the other hand, this would deprive a number of men of work. The advantage gained by these labour-saving appliances is really very trifling; the disadvantage to the working man is very great. A number of men are thrown out of work by them, and these men go to swell the ranks of the unemployed. Do not, he said, be carried away by this idea of labour saving, unless there is a real necessity, or an economy such as cannot be ignored, for saving labour. There are a good many things that can be better done by human agency than by mechanical means.

VICTORIAN GAS MANAGERS' ASSOCIATION.

Second Annual Meeting..

The Second Annual Meeting of the Association took place on Wednesday, Nov. 6, at the Rooms of the Victorian Institute of Engineers, Melbourne. There was a large attendance of members —the PRESIDENT (The Hon. George Swinburne, Assoc.M.Inst.C.E., of Melbourne) being in the chair.

The PRESIDENT, having expressed his pleasure at seeing so many members present, said he was very sorry that Mr. R. O. Thompson, their esteemed ex-President, was unable to be with them, as he had had to go to West Australia.

The minutes of the previous annual meeting were taken as read, and the balance-sheet, showing a sum of £2 1s. 10d. in hand, was received and adopted.

ANNUAL REPORT.

The HON. SECRETARY (Mr. P. C. Holmes Hunt) then read the second annual report, in the course of which the membership of the Association is given as 42. There were, however, still several gentlemen connected with gas-works who had not yet joined; and the Council urged members to extend the roll, so that the Association may be truly representative of every part of the State. Dealing with the balance-sheet, the Council remark that the greatest expenditure in the accounts during the twelve months had been for the printing of the "Transactions." Having outlined the proceedings at the annual general meeting in 1906, under the presidency of Mr. Thompson, the Council remark that they have, "with deep regret, observed that increased duties on gas appliances are proposed under the new tariff submitted to the Federal Parliament, and that grave injustice is being done to the gas industry by reason of corresponding articles used in electric supply being admitted at a lower rate. The matter has been prominently brought before the Federal Government; but the Council have decided to submit a resolution to the members in connection with the duties and the unfair position in which the gas industry is placed in comparison with its competitors, so that the Association may discuss the whole question and forward their opinion officially to the Minister of Customs." The report concludes with an acknowledgment of the receipt, from the Southern District Association of Gas Engineers and Managers, of a copy of their report on the "Naphthalene Inquiry, 1901-1906."

The PRESIDENT said he was sure they would all agree with the Council that it was the right thing to issue the proceedings. They should feel grateful to Mr. Hunt—their energetic Honorary

Secretary—for the trouble he had taken in editing the "Transactions," and arranging that they might all have a copy of last year's work. He felt that the Association would be of immense use to the gas industry of Victoria, and also make its influence felt throughout Australia. They were also recognized, even at this date, at Home by some of the Gas Institutions there. As mentioned in the report, the Southern District Association had sent them a report in connection with their naphthalene inquiry; thus recognizing their position in Australia.

Mr. WARREN (Footscray) moved that the report be received and adopted. In doing so, he would point out the injustice of the duties under the new tariff in regard to gas-meters, &c. He had mentioned the subject to Mr. Mauger, the Member for Footscray, who had passed the matter over to the Minister of Customs; and he had received a letter from the Secretary for Customs stating that the question should be deeply looked into. He had it on very good authority that when gas-meters were proposed to be similarly taxed in New Zealand, the injustice of doubling the duty was pointed out, and the Minister for Customs there abrogated the duty altogether, since when gas-meters had been admitted to New Zealand free.

Mr. J. W. THOMPSON (West Melbourne) seconded the motion, which was unanimously carried.

NEW MEMBERS.

The HON. SECRETARY reported that three nominations of new members had been approved by the Council—namely, J. H. Grice, Junior Assistant in the Metropolitan Gas Company; T. W. R. Lord, Assistant in the Geelong Gas Company; and T. Gale, Assistant in the Footscray Gas Company.

These gentlemen were unanimously elected junior members.

THE NEW TARIFF.

The PRESIDENT said they were very glad indeed to see visitors there from the other States. They had Mr. Aird, the Manager of the Townsville Gas Company present, and Mr. Humphries of Box Hill, late of Charters Towers Gas Company. They were very glad to welcome gentlemen from elsewhere in Australia to take part in the discussions. The next item on the programme was in connection with the tariff matter mentioned in the report. It was suggested therein that a resolution be proposed and adopted for transmission to the Minister for Customs. The resolution was as follows:

That this meeting of the Victorian Gas Managers' Association respectfully draws the attention of the Hon. the Minister of Customs to items in the tariff now before the House of Representatives which unfairly gives preference to electric light apparatus to the detriment of gas apparatus and the Australian manufacturer—namely, electric meters have been raised from the free list to a duty of 5 per cent., while gas-meters have been raised from 12½ per cent. to 25 per cent. duty. It is submitted that electric-meters should be placed on the same basis as gas-meters. Gas-mantles are raised from 15 per cent. to 30 per cent. duty for British and 40 per cent. foreign; while carbons for electric lamps are continued on the free list, except for foreign manufacture, which are 5 per cent. This gives a most unfair advantage to electric lamps, and it is considered should be rectified. Further, that on low-priced globes the duty proposed will be equal to 250 per cent., while on high-priced globes it will only be 15 to 16 per cent. This penalizes the poorer consumer very severely. This Association considers that the raising of the duty from 20 per cent. to 1s. 6d. and 2s. 6d. per cubic foot on chimneys and globes which are not made in Australia is a most serious matter to the average consumer, especially as the freight is a very heavy item in addition. It is suggested that the duty which is absurdly excessive should be *ad valorem*, as before.

The various gas companies had already approached the Minister; but they thought it best that the gas managers should approach the Commonwealth Government as a body to point out the injustice done to the gas industry by the heavy penalties put upon apparatus used in gas-works as compared with that employed by electric light undertakings. He moved that a copy of the resolution be sent to the Hon. the Minister for Customs. Nearly all gas-meters were now being put together in Australia. A very large proportion of the duty—nineteen-twentieths—was being paid upon the parts. If electric-meters were to be brought in free, it would mean that no work would be done on electric-meters in Australia, and that the electrical people would be benefited by about 20 per cent. in duty as compared with gas-meters.

Mr. FROST (Beechworth), in seconding the motion, said he would be inclined to go a little further and appoint delegates from the meeting to go as a deputation to the Minister for Customs.

The HON. SECRETARY pointed out that the Minister had declined to receive any more deputations.

The PRESIDENT said that the matter of mantles was an important one. The duty being put on now practically placed the whole of the business into the hands of the Welsbach Company, and prevented any competition unless other manufacturers started there. They did not object to any reasonable duties, so long as their competitors were placed in the same position as they were. The Minister for Customs had declined to receive any further deputations on tariff matters; but he thought that if he was approached privately or by letter he would hear their overtures, and the members of the House of Representatives would also see that they received fair treatment.

Mr. S. E. FIGGIS (Ballarat) said it did not seem necessary that they should discuss the matter, since the resolution itself covered the ground. He thought, as the President had said, that if the gas industry were placed on a similar footing with the electric lighting companies, they should be perfectly satisfied.

The motion was carried unanimously.

PRESIDENTIAL ADDRESS.

The PRESIDENT then read his inaugural address, which was given in the "JOURNAL" last week (p. 95).

Mr. FIGGIS proposed a hearty vote of thanks to the President for his comprehensive and instructive observations.

Mr. C. W. HOWLETT (South Melbourne), in seconding the vote of thanks, said there could be no doubt that the figures which the President had given them had taken some time to collect, and they formed very effective proof that gas was making headway.

Mr. HOLMES HUNT (Melbourne) said he could not let the occasion pass without expressing his thanks for the kindly reference that was made by the President to himself. The address read by the President had involved a great deal of work; and they could imagine what that meant to one who, like him, had so much to do. He had given them figures and particulars about the industry in Victoria that he (Mr. Hunt) had never been in touch with before; and they were therefore particularly interesting to him. They could not, of course, discuss the address; but he would just like to refer to two points by the way. He considered the reductions in the price of gas in the various towns mentioned by Mr. Swinburne extremely interesting. They bore out the old argument that a reduction in price increased consumption; but he thought, too, the main point about these reductions was that they were practically wholesale reductions—proving that big reductions must be made from very high prices, such as obtained in many parts of Victoria, in order to get the results wanted. The President referred also to the testing of electric-meters. He was sure they were pleased to know that this was gradually coming to the front in the Old Country; and he hoped it would become uniform everywhere, as was the testing of gas-meters.

The motion was carried unanimously.

The PRESIDENT, in thanking the members for their kind and appreciative resolution regarding his address, said to prepare it had been to him quite a pleasant interlude from political worries. If there was anything in the address that would be of use to them, it would be an additional pleasure to him. There was one point which he would like to lay stress on, and that was the collecting of statistics with regard to Victorian gas-works as he had suggested. If the gas managers would assist him or the Council during next year by replying to their inquiries and filling in sheets that they would send them, they should be able to compile tabulated statistics and get more useful information for discussion at the next meeting.

READING OF PAPER.

The reading of a paper on "Gas Coal," by Mr. D. Warren, was then proceeded with. An abstract of this, together with a report of the discussion on it, will be found on p. 160. A paper on "Regenerative Furnaces for Small Gas-Works" had been promised by Mr. Burall, of Warrnambool; but he had been unable to complete it. The Council therefore arranged for a discussion on the subject. This will be found reported on p. 161.

QUESTION BOX.

There were several items in the "Question Box" for discussion; but time did not permit of more than two being dealt with. These will be found reported on p. 165.

THE NEW OFFICE BEARERS.

The election of officers resulted in the following gentlemen being appointed for the year, 1907-8.

President—Mr. S. E. Figgis (Ballarat).
Vice-President—Mr. Thomas Lord (Geelong).
Member of Council—Mr. W. Pain (Bendigo).
Auditors—Messrs. J. Bowman (Sale) and J. Lord (Williamstown).
Hon. Sec. and Treasurer—Mr. P. C. Holmes Hunt (Melbourne).

Mr. FIGGIS thanked the members for the honour done him in electing him President, and gave them a cordial invitation to visit Ballarat for the meeting next year, which was enthusiastically accepted.

VOTES OF THANKS.

Mr. HOLMES HUNT said that there was just one other thing left to be done, and that was to pass a vote of thanks to the President for the way he had presided over their deliberations during the two days. He was quite sure he was only voicing the sentiments of every member in saying that they were all extremely proud in having a gentleman like Mr. Swinburne at their head—one who had been through so much pioneer work in the manufacture and distribution of gas in Victoria, and who had risen to the high position which he held in the State to-day. Mr. Swinburne was an extremely busy man, and, as they all knew, full up with political work. He moved that a hearty vote of thanks be accorded to him.

Mr. T. LORD (Geelong) seconded the motion, which was carried with acclamation.

The PRESIDENT, in acknowledging the vote, said it was quite unnecessary for them to thank him, for being there had been a very selfish matter on his part. He was the one who had enjoyed it most; it was a pleasure for him to get out of public life and be among old friends again. He thanked them very much for their kind resolution.

WEAK MIXTURES IN GAS-ENGINES.

In last week's issue we published some extracts from a paper read by Mr. JAMES ATKINSON on the previous Friday evening at the meeting of the Institution of Mechanical Engineers. It was followed by one by Professor BERTRAM HOPKINSON, of the University of Cambridge, on "The Effect of Mixture Strength and Scavenging upon Thermal Efficiency." The contents of this paper are indicated this week, and are accompanied by a few notes of some of the most practical points in the discussion to which the two papers gave rise.

In the first part of the paper, Professor Hopkinson dealt with the effect of strength of mixture on thermal efficiency. He gave the following table, showing the results of a series of tests which were all taken within two or three hours.

Gas.		Mean Effective Pressure.	Efficiency Per Cent.	—
Cubic Feet Per Suction.	Percentage of Cylinder Contents.*			
0·1275	11·00	102·2	32·5	Full load.
0·1147	10·00	98·4	34·7	,, ,,
0·1005	8·65	90·2	36·5	,, ,,
0·1275	9·50	108·4	34·5	Light load.
0·1140	8·50	101·6	36·1	,, ,,

* Calculated on the assumption that the full-load suction temperature is 100° C., and the light-load suction 50° C.

The author pointed out that in no case did the mean pressures determined differ by more than 1½ lbs. per square inch, or 1·6 per cent.; and the average difference was about 1 per cent. Thus the mean pressures given, which were the means of the two observations, might, he said, be taken as correct in every case to within 1 per cent.

A diagram was given showing the relation between gas consumption and mean effective pressure, and in regard to it the author explained that as all the observations shown were taken within two or three hours, it might be assumed that the calorific value of the gas remained the same during that time. The calorific value was not taken at the time of the test, and the efficiencies were calculated on an assumed lower calorific value of 600 B.Th.U. per cubic foot at standard temperature and pressure—a value which accorded with measurements made a day or two after the test. The relation between the efficiencies with different gas consumptions, which it was the main object of the experiment to determine, was unaffected by any error in the calorific value or in the calibration of the indicator, and was shown with great exactness in the above series of figures. That the absolute values were also fairly close was shown, however, by tests made at other times in which the calorific value was measured at the time of the test. In some trials, the indicated power was calculated from the brake power and the indicated power at no load, as in the trials conducted by the Institution of Civil Engineers, but with a proper deduction for the difference in pumping work as between light and full load. The results of one such test are shown in the following diagram :—

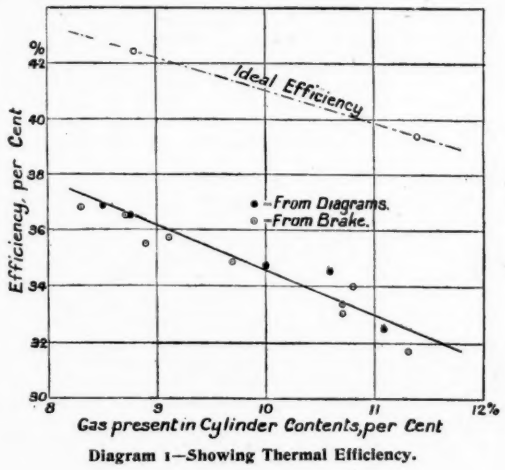


Diagram 1—Showing Thermal Efficiency.

Full Load.

Gas used, 0·1006 cubic foot per suction, at 52° Fahr. and 30·46 in. bar. Calorific value (measured at time), 570 B.Th.U. per standard cubic foot.

$$\frac{\text{Gas}}{\text{Total charge}} = 0{\cdot}0865$$

$$\frac{\text{Explosions}}{\text{Cycles}} = 0{\cdot}896$$

B.H.P. = 34·4. Efficiency on B.H.P. = 32·2 per cent.
Jacket temperature = 190° Fahr.

Light Load.

[Taken as soon as the brakes were off.]

Gas, 0·1129. Mean pressure calculated from gas consumption, 100 lbs.
Explosions ÷ cycles = 0·138. I.H.P. = 6·9.
Extra pumping work, 0·896 × 2·3 = 2.
∴ Mechanical losses = 4·9
Indicated horse power = 39·3
Mechanical efficiency = 87·5 per cent. } at full load.
Thermal efficiency = 36·8 ,,

The thermal efficiency at full load is plotted in terms of strength of mixture in the preceding diagram. The straight line which most nearly represents the mean efficiency is drawn through the points, about equal weight being given to diagrams and brake tests. A number of other tests were made, the general results of which are given in the following table, taken from one of the appendices to the paper :—

Table of Results of Efficiency Tests.

No. of Trial.	Lower Calorific Value.	Gas Charge.				Thermal Efficiency.	Calculated Efficiency.	Remarks.
		Cubic Foot per Suction.	Explosions. Cycles.	Per Cent. of Mixture.	Per Cent. Corrected.			
1 a	600	0·1275	1·0	11·1	11·1	32·5	32·8	Diagrams only
1 b	,,	0·1147	,,	10·0	10·0	34·7	34·6	
1 c	,,	0·1005	,,	8·75	8·75	36·5	36·6	
2	582	0·1180	0·8	10·0	9·7	34·8	35·1	Brake and diagrams
3	575	0·1006	0·9	8·6	8·3	36·8	37·3	Brake
4 a	600	0·1304	0·8	11·0	10·8	34·0	33·0	Brake
4 b	,,	0·1066	0·9	9·1	9·1	35·7	36·0	
5 a	600	0·1220	1·0	10·6	10·6	34·5	33·8	Diagrams
5 b	,,	0·0990	,,	8·5	8·5	36·8	37·0	
6	610	0·1310	0·8	11·1	11·3	31·7	32·5	Brake
7	600	0·1151	1·0	10·0	10·0	34·7	34·6	Diagrams
8 a	605	0·1012	0·9	8·6	8·7	36·5	36·6	Brake
8 b	,,	0·1280	0·8	10·6	10·7	33·4	33·5	
9 a	605	0·1030	0·9	8·8	8·9	35·5	36·4	
9 b	,,	0·1270	0·9	10·6	10·7	33·0	33·3	

In regard to this table, the author explained that the trials under the same figures were comparative tests made at the same time. In trials Nos. 1, 4, and 5, the calorific value was assumed to be 600 B.Th.U. per standard cubic foot, which was the average value when the tests were made; in the others, the calorific value was measured at the time. The gas consumption given is the volume as measured in the holder. "Per Cent. of Mixture" is the fraction of coal gas in the mixture as it is in the engine after dilution with the contents of the clearance space. Where (as in trial No. 8) the engine was missing an appreciable number of explosions, allowance is made, in calculating the percentage composition, for the fact that the dilution is greater after a scavenging stroke; and the average percentage is given. "Per Cent. Corrected" is the equivalent percentage of coal gas having a calorific value of 600 B.Th.U. It is proportional to the heat supply per standard cubic foot of the cylinder contents. "Thermal Efficiency" is the ratio of indicated power to heat supply (lower value); the indicated power being taken from the positive loop of the diagram only, without any deduction for pumping. There is a possible error of about 2 per cent. in the indicated power, whether from diagrams or brake, and of about the same amount in the heat supply. An error of 4 per cent. in the ratio of these quantities may therefore occasionally occur, equivalent to about 1·3 in the efficiency. All the observations of efficiency agree with the straight line in Diagram I. within that limit; and the probable error in calculating the mean pressure from this straight line does not exceed 2 per cent., assuming the heat supply to have been accurately determined.

The strength of mixture is calculated on the assumption that the suction temperature with a full load is 100° C., and with a light load (scavenged charges) 50° C. There is some uncertainty about these temperatures, and a corresponding uncertainty in the absolute value of the proportion of coal gas in the mixture. But as the total weight of charge is practically independent of the strength of mixture (if the engine be kept fully loaded and the jacket temperature constant), the relative values of the proportions under full-load conditions are unaffected by this uncertainty. The scavenged charges are dealt with later. The weakest mixture used in these tests contained about 8·65 per cent. of coal gas when in the engine; the proportion of air to gas drawn in being about 9½ : 1. Weaker mixtures than this, however, would not ignite regularly. At the other end of the range, the proportion of air to gas was about 7½ : 1; the excess of air being about 1½ times the volume of gas. Slightly heavier charges than this could be used; but it is possible that the combustion would not be complete, and the pressures in the engine would become dangerously high. The range of mixtures tested therefore covers all which could be practically used. Within that range, the efficiency diminishes steadily as the strength of mixture increases; the difference between the weakest and strongest charge amounting to 4½ per cent. in efficiency, or 12 per cent. on the work done.

Passing on to consider the causes of higher efficiency being obtained with weaker mixtures, Professor Hopkinson pointed out that the circumstance that the efficiency will increase as the

strength of mixture is reduced, so long as the combustion is substantially complete, is to be expected from the now well-established fact that the specific heat of the working substance increases with the temperature. The work done in the gas-engine cycle is mainly determined by the rise of pressure which occurs on explosion; and in the same engine the area of the diagram with different mixtures is about proportional to this rise, when corrected for the change of volume during combustion. If the specific heat of the working substance were constant, as is assumed in the air cycle, the rise of temperature, and therefore of pressure, at the explosion end of the diagram would be proportional to the heat supply, and the efficiency would therefore be constant. But the specific heat being, in fact, greater at high temperatures, the rise of temperature or of pressure on explosion increases in a less ratio than the heat supply, and the efficiency therefore diminishes as the supply of heat is increased.

The ideal efficiency of a gas-engine, by which is meant the efficiency which would be attained if all heat losses to the walls were suppressed, and if combustion were complete and instantaneous at the in-centre, is easily calculated if the internal energy of the working fluid is known as a function of its temperature. It cannot be said that we yet possess this knowledge in any high degree of accuracy, but enough is known to enable an estimate to be formed of the effect of strength of mixture on efficiency.

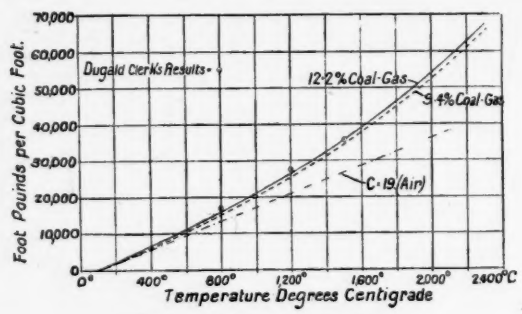


Diagram II—Internal Energy Curves.

Diagram II. shows the internal energy curves corresponding to the weakest and strongest mixtures used in the experiments. The ordinate of the curve is the quantity of heat in foot-pounds required to heat a standard cubic foot of the burnt products, at constant volume, from 100° C. up to the temperature represented by the abscissæ. The curves were calculated from the figures given by Langen for the specific heats of carbon dioxide, steam, and air between 1500° and 1900°, and from the results of Holborn and Austin, and Holborn and Henning, at lower temperatures. The values given by Mr. Dugald Clerk for a mixture of intermediate composition are also shown. The ideal engine efficiencies for the two mixtures can be calculated from these curves by the method given by the author in the discussion on Mr. Dugald Clerk's paper "On the Limits of Thermal Efficiency in Internal-Combustion Engines," read before the Institution of Civil Engineers.* The ideal efficiencies corresponding to mixtures containing respectively 8·8 and 11·4 per cent. of coal gas, calculated by this method, are 42·4 and 39·4 per cent. For mixtures of other compositions, the efficiency follows a straight-line law sufficiently nearly for present purposes, and this straight line is shown broken in Diagram I.

Dealing with the effect of scavenging, the author explained that when the engine is running light or partially loaded, so that each explosion stroke is followed by one or more scavenging strokes, the suction temperature is about 50° C., against 100° C. when running fully loaded. With a given charge of gas, therefore, the mixture will be weaker under these conditions than when fully loaded; and the efficiency should be correspondingly higher. For example, if the engine is taking 0·11 cubic foot of gas per suction, the percentage of coal gas in the charge will be about 9·6 when running fully loaded; but it will be only 8·2 when the engine is scavenging. Referring to Diagram I., it will be seen that the corresponding efficiencies are about 37½ per cent. and 35 per cent. respectively. There is some uncertainty about the suction temperatures on which this calculation is based (taken to be 100° C. and 50° C.); but, making full allowance for this, it may be said that the mean pressure realized with the same charge of gas should be at least 5 per cent. greater when the engine is scavenging than when it is running fully loaded—assuming, of course, that the strength in each case is such as to give regular and normal ignition.

A number of experiments were made with the object of testing this conclusion. Diagrams were taken with the engine running light on half-load, and were compared with full-load diagrams taken at the same time; the gas consumption being measured in each case. The results of one such test have already been given in the first table, from which it will be seen that a gas charge of 0·1275 cubic foot gave a mean pressure of 108·4 on light load, as against 102·2 when fully loaded. Further, a charge of 0·100 cubic foot at full load, and of 0·114 cubic foot at light load, corresponding in each case to a mixture strength of about 8·5 per cent., gave approximately the same efficiency of 37 per cent.

* See "JOURNAL," Vol. XCVII., p. 624.

These results were confirmed generally by other diagrams taken at light load, and also by running the engine at half-load, so that most of the explosion strokes were followed by one or more scavenging strokes. The results, however, were not so consistent as in the full-load tests; the mean pressure sometimes falling short by as much as 6 per cent. of that which was anticipated from the gas consumption. In the case of the full-load trials, the mean pressure can be predicted from the gas consumption within 2 per cent. This want of regularity is due in part to variation in the suction temperature, which was always assumed to be 50° C. after a scavenging stroke and 100° C. after an explosion. As a matter of fact, both temperatures vary to some extent with the number of explosions per minute, and possibly also a little with the charge of gas. There will be corresponding differences between the actual mixture strength and that calculated. But a more important cause of irregularity is the fact that the combustion of a scavenged charge is generally incomplete; the fuel discharged unburnt sometimes amounting to 4 or 5 per cent. In all, four analyses were made of the exhaust when the engine was missing about every alternate stroke. The quantities of unburnt gas found were respectively 4·2, 3·2, 5·4, and 4·5 per cent.—an average of 4½ per cent.

These analyses are not so accurate as those at full load, because of the dilution of the exhaust with air; and there seems to be some selective combustion, as the quantities of steam and carbon dioxide formed in the combustion-tube are usually not in the proportion obtained by the complete burning of the coal gas. But there is no question that a good deal of unburnt gas is sometimes discharged when the engine is missing explosions. The effect is quite apparent in the heat-balances at half-load, which all show a greater deficiency than can be accounted for by radiation. Five trials at half-load showed unaccounted-for balances ranging from 297 to 433 B.Th.U. per minute—the average being 350 B.Th.U., or about 10 per cent. on the heat supply (higher value). Six trials at full load with the same jacket temperature (75° C.), and taken with the same appliances, showed deficiencies ranging from − 58 to + 189 (average + 25) B.Th.U. The systematic errors referred to above were probably the same in all these trials. The radiation is a little greater in the full-load trials because the piston is hotter; but the difference in this respect cannot be very large. Thus, after allowing for radiation, the unaccounted-for heat in the half-load trials is some 300 B.Th.U. per minute more than at full load; and this must be mainly due to a greater proportion of unburnt gas. In the last of these trials, the thermal efficiency obtained from the brake load by the addition of the mechanical losses (separately measured at the same time by observing the light-load indicated power) was 32·7 per cent. About three-fourths of the explosions were followed by scavenging strokes, and the charge of gas was 0·1285 cubic foot as measured in the holder. The average strength of the mixture, calculated on the above-mentioned assumptions as to the suction temperature, was 10 per cent., and the corresponding efficiency 34·5 per cent. Thus the mean pressure was 5 per cent. less than that calculated. In this case, 4½ per cent. of unburnt gas was found in the exhaust; and the deficiency on the heat-balance was 433 B.Th.U. per minute, out of a total supply of 3740 B.Th.U.

It is not possible to say how far the combustion is incomplete when the engine is running quite light; but it seems likely, from the high mean pressures sometimes realized under these conditions, that it may, under some circumstances, be more nearly complete than in the half-load tests. From a study of the latter, it would appear that, when allowance is made for the gas discharged unburnt, the efficiency is not much affected by scavenging, provided the strength of the mixture is kept the same, which implies an increase of about 15 per cent. in the charge of gas, with, of course, a corresponding increase of mean pressure.

Discussion.

The PRESIDENT (Mr. T. Hurry Riches, of Cardiff) said he had much pleasure in proposing a cordial vote of thanks to Mr. Atkinson and Professor Hopkinson for their admirable papers. The subject was a very live one; and as the years went on, he was more and more satisfied they had a great deal to learn about it. A more economical use of fuel and the products of fuel, he was quite satisfied, was of vital importance to the future of engineering. He was sure there was a great future for the gas-engine—a much greater future than at the moment appeared possible. Time and experiment he was convinced would elaborate and extend its usefulness, efficiency, and economy.

Mr. J. EMERSON DOWSON observed that the two papers were of very different character, and dealt with different branches of the subject. He would confine himself to a few remarks on Professor Hopkinson's contribution. The first point was the very interesting fact that, within certain limits, weak mixtures gave a higher heat efficiency than strong mixtures. This was a kind of pill he had experienced some little trouble in swallowing, because for some years, in dealing with producer gas, he was urged by gas-engine manufacturers to make the gas as strong as possible, and, above all, to have in it a high percentage of hydrogen—chiefly for the purpose of getting sure and prompt explosions in the cylinder. He could then easily give them 20 per cent. of hydrogen. The practice had since altered very considerably; and the higher compressions had entirely changed the working. The 20 per cent. of hydrogen in the producer gas was now rather a drawback than an advantage. In fact, he had some little difficulty to realize at first how easy it was to get a good

mean pressure and a good heat efficiency with a poor gas—that was to say, gas of low calorific power. But some three years ago, he had experiments made bearing on this particular subject; and Professor Hopkinson might be interested to know that, so far as these tests went, they fully confirmed what he had been telling them in the paper. He (Mr. Dowson), in the experiments, dealt with a poor gas—it was a gas that had a calorific power of only from 100 to 120 B.Th.U. per cubic foot; and he was simply surprised to find that he got such good indicator diagrams, and that the heat efficiency turned out so well. This was a most important thing in gas-engine practice. Regarding scavenging, for twenty years or more, he had been an advocate of scavenging, having in view producer gas. Personally, he had not given any attention to coal gas. The experiments in the paper referred to coal gas; and he hoped they might lead to some exhaustive trials being made with producer gas, because he thought it was an important subject. He should like to see someone like Dr. Hopkinson, with his great skill and care, tackle the question thoroughly, and let all interested know whether there was anything good or bad in it. Scavenging for the larger engines was more or less used now; but here they learned that, though they got an increase in the mean pressure of 45 per cent., there was a loss at the same time from incomplete combustion. This was a very disappointing fact; and he confessed it was new to him. He should like to see the point tracked down. They might find the means to provide for the increase in mean pressure, and at the same time not have to sustain the loss from any unburned gas. It was not a mere question of raising the mean pressure; there were other advantages in scavenging. There was the prevention of preignition, and also the avoiding of excessive strains after a misfire. And when dealing with producer gas, there was the further point (which was very important) that it was a poor or weak gas that was being dealt with, and so ought not to be diluted with residual products; and it was on this particular ground he had always felt that scavenging should be an advantage with producer gas. If Professor Hopkinson could see his way to further investigate this question with reference to producer gas, all engineers would be extremely grateful to him. He (Mr. Dowson) would be only too pleased to place at his disposal any information on the subject, and lend him a gas plant with which he could experiment if it would be of any use to him.

Mr. Henry Lea (Birmingham) said it seemed to him that Professor Hopkinson, in adopting the gasholder for measuring the gas in these comparative tests, was absolutely correct, and that he could not have applied a more perfect method. It was quite evident that the engine he used was one that drew in gas throughout the whole suction stroke, and that no attempt was made to deal with the gas on the lines proposed by Mr. Atkinson in his paper. Much to his (Mr. Lea's) delight, too, he seemed to have had an engine to which he gave the freest access of atmospheric air. It had long been his conviction that an engine could not be given too free a supply of air. The result was that, when the compression stroke began, the cylinder was practically full of mixture at atmospheric pressure; and therefore the designed compression was attained, which was not the case when, with throttle governing, the cylinder was only partially filled with mixture. Herein was a source of inefficiency in many engines. He had seen gas-engines which were simply labouring for breath; and if they had been set free, a great deal more power, and a great deal better efficiency, might have been got out of them. He agreed with Mr. Atkinson about the close governing of the hit-and-miss arrangement; and he did not think it would be easy to devise anything better. As Mr. Atkinson said, they were governing by it practically on a hair line, and yet were in reality giving the governors nothing to do. He could not understand how Mr. Atkinson, with hit-and-miss governing, as compared with throttle governing, got such a small difference per brake horse power. In one of his diagrams, there were two curves—one in full line (throttle governing) and the other dot-and-dash (hit-and-miss), relating to a 47 brake-horse-power engine; and the vertical distance between the two lines at a point at which they were widest apart amounted to about 11 per cent. only. In motor-car driving, he had made some careful tests of fuel consumption on a car fitted with hit-and-miss and with throttle governing; and whereas with hit-and-miss governing—running over the same road the same distance, in the same kind of weather, and with the same load—they got 39 miles out of the car for a gallon of petrol, they could not do better than 22 miles with throttle governing. The difference between these two figures was 44 per cent. He should like to know why throttle governing on a motor-car reduced the efficiency 44 per cent., but in a gas-engine only 11 per cent. He suggested that the variations Mr. Atkinson found in the calorific power of the Manchester gas might be due to the variations in the moisture in the air and gas, and referred for confirmation to Professor Burstall's third report to the Gas-Engine Research Committee, which was presented to the Institution in January last. Before concluding his remarks, Mr. Lea introduced a method he had himself devised for governing the gas admissions to internal-combustion engines.

Mr. E. J. Davis (Stratford) remarked that some fifteen years ago he wrote a series of articles for the "Mechanical World;" and at that time he stated, after experimenting, that the best mixture was obtained with 8 of air to 1 of gas. This proportion would give the most economical charge at 60 lbs. compression. In reference to the efficiencies of varying gas charges, he did not think Professor Hopkinson had given the stronger charge such a good chance as the weaker one. He (Mr. Davis) found that though a gas-engine might seemingly be igniting at dead-centre, the firing line might be at an angle instead of vertical. He found the best efficiency was given when the line was not vertical, but when it came off at an angle. But for the stronger charges, Professor Hopkinson had a vertical firing-line; and for the weaker charges, the firing-line was at an angle.

Mr. Barker and Mr. Wimperis commented on the diagrams and formulæ; and then the authors were called upon to respond—as concisely as possible, owing to the lateness of the hour.

Mr. Atkinson, in his reply, said that Mr. Lea had spoken of the value of the holder for measuring the gas; and in this he agreed with Mr. Lea and also with Professor Hopkinson. It was the means adopted to measure the gas in the large engine test by Dr. Nicolson referred to in his paper. In that case, a large holder was required to measure the gas correctly. It was 30 feet diameter by 12 feet lift; thus being large enough to run for a sufficient length of time to get the results correctly. He was glad Mr. Lea also advocated the method of governing used on that engine. There was no doubt that it was a very satisfactory method. He (Mr. Atkinson) was particularly pleased to note what Professor Hopkinson said in his paper about stratification as being one satisfactory method of burning weak charges in a gas-engine. That one of the latest forms of gas-valve applied to the Crossley engines did stratify the gas, was clearly indicated in diagrams, which showed prompt ignition with even weak mixtures. There was a satisfactory reason why the valve was economical on the medium and lower loads. Where they had a gas-engine governed by quantity governing, they must have a rich mixture under most circumstances to enable the engine to give its maximum loads. When on light loads, they must still have a rich mixture, but less of it. On quality governing, they only had the rich mixtures when on maximum loads; for anything below, they had a weak mixture which would burn very economically, as explained by Professor Hopkinson. Regarding the reasons why weak mixtures were more economical than strong ones, he said it was found that in a strong mixture some particles of the gas would not have their corresponding equivalent particles of oxygen near them, while with weak mixtures there was every probability of every particle of gas having its proper equivalent of oxygen. In a large engine, at the time of compression, the charge was approaching the temperature of ignition, and the shock of the explosion of the charge would ensure the burning of all isolated particles of gas, and none was left unconsumed. He thought this was one explanation why weak mixtures were more economical than strong ones; and stratification (which the valve to which he had referred enabled one to secure) was a satisfactory way of getting these weak mixtures and ensuring them being burned. He was pleased indeed to note that Mr. Lea agreed with him as to the proper way of governing gas-engines; and it was satisfactory for them both to know that they were in this matter in accord with most people who had to deal with large engines.

Professor Hopkinson said he should very much like to carry out some tests on producer gas; and he hoped to avail himself of Mr. Dowson's kind offer to place some plant at his disposal for the purpose. He chose coal gas rather deliberately for these particular experiments, because one could be sure that for an hour or two its calorific value would remain constant, because its volume was easy to measure, and because one could get a wide range with it. Of course, for practical application, one ought, he knew, to experiment on producer gas. Mr. Dowson had asked him about the effect of scavenging. He referred particularly to tests in the paper which showed that the combustion of the scavenging charges in the engine were not complete, and he asked whether he (Professor Hopkinson) could say anything about the reason for this. He was afraid he could not. However, he had not the least doubt about the fact, but it was a puzzling fact; and he had not at present any conclusive theory to offer. Mr. Lea referred to the effect of water vapour upon the calorific value of the gas, and to Professor Burstall's tests. His (Professor Hopkinson's) feeling about water vapour was that, at any rate in coal gas, it could not make much difference. The variations in the quantity of water vapour could not be very great; and he did not think the error from this cause need be any greater than the ordinary error of the calorimeter. He took the gas from the same main for both engine and calorimeter.

The vote of thanks to the authors was heartily agreed to.

The late Mr. Charles Gott, of Bradford, whose death was recorded in the "Journal" for the 10th ult., left estate of the value of £30,651 gross and £25,538 net.

After having been under discussion for three years, the scheme for the establishment of a German Imperial institution for chemical research, on lines similar to those of the Physical Technical Reichsanstalt founded at Charlottenburg in 1887, is now making progress, according to the "Chemical Trade Journal." At a recent Berlin conference of the Grand Committee for the furtherance of the project, approval was given to the proposed statutes for the establishment, and an association was formed under the title of the Chemische Reichsanstalt. On this basis, individual contributions totalling £40,000 have been made, together with annual subscriptions amounting to £1700. The Council of the new organization is composed of Privy Councillors Emil Fischer and W. Nernst, and Dr. Oppenheim, of Berlin.

GAS COAL.

By D. WARREN, of Footscray.

[Abstract of a Paper read before the Victorian Gas Managers' Association.]

In his paper, the author dealt chiefly with purely local matters. After referring to the properties of coal and the qualities necessary in a good gas coal, Mr. Warren remarked on the large coal territory in Australia, pointing out that the coal is of very good class, and, in his opinion, equal, at any rate, to that generally found in other parts of the world. He then proceeded to deal chiefly with the question of price, referring especially to the recent large increases in the selling price of coal which have taken place in Australia, and declared that not only had the price been raised as a result of a bigger demand for coal in foreign countries, but also that the shipping companies had increased their freights unnecessarily, with the object of recouping themselves for losses made during the period of bad trade. In considering means to meet this increase, the writer suggested amalgamation among the small gas companies, and went on to say: Our present way of keeping ourselves supplied with gas coal seems to me to be a pettifogging method—each company procuring its coal independently; but an amalgamation for the purchase and supply of gas coal would tend to make coal owners and merchants feel our custom was worth their attention, and would also perhaps tend to assist gas companies in keeping larger stocks on hand.

As a further means of meeting the position, the author suggested an export duty on coal, and argued that every shipload that leaves the shores of Australia was so much capital taken away from the country: "Our population gets nothing from it but the first cost, and there it ends. To remedy this, Why should not an export duty be put on coal? We and other manufacturers have to pay heavy and excessive duties on articles that cannot be produced here, and thus have to be imported. Why should our very life's blood be taken away by all and every nation's mercantile navy without the Federated States receiving payment in return? Moreover, why should not every non-Australian ship stand on one side while Australian ships are being loaded with their own products? Would not such legislation tend to steady the vacillating prices of gas and other coals?"

The author also pointed out that he considered the stocks of coal kept by the smaller companies as altogether too small, and suggested that better accommodation should be provided to store coal, and thus reduce the possibility of it deteriorating by the action of weather and light.

Discussion.

Mr. BEARUP (Hamilton) said there was one point that had particularly struck him in the paper, and that was the proposed amalgamation of small gas companies for the purpose of calling for tenders for coal. They would, by doing this, perhaps secure coal at a far lower rate than they obtained it now. He should say that twenty small gas companies could arrange to call for tenders together.

The PRESIDENT said that no doubt a large company could get coal cheaper than a small one, and a larger company than that could get it cheaper still. It was almost the old story of the survival of the fittest. A company consuming 600 tons of coal had an advantage of probably 1s. to 1s. 6d. per ton over a company consuming only 200 tons; and a company that consumed 1200 tons had a corresponding advantage over the one that consumed 600 tons. As the consumption went up, there was a distinct advantage.

Mr. J. BOWMAN (Sale) said no doubt a combination could be effected between various small companies with very great advantage in the matter of buying; but he thought that the action the Premier had taken in connection with the Coal Creek Mine for the State pointed a better way. Why should not all the gas companies get together and buy a coal mine in New South Wales? He thought that if they could not buy a mine outright, they could buy a controlling interest in one; and by this means get coal that would suit all of them at a reasonable price. The carrying service was, of course, a difficulty in the matter. But why could they not arrange for a steamer of their own to carry their coal? The big steamers that at present brought the coal carried it at from 5s. to 15s. per ton, according to what they could get. The scheme was worth consideration.

Mr. BEAN (Wangaratta) said he was not sufficiently acquainted with the circumstances in Australia; but last year the question was brought forward as to whether large or small coal was the best to use in small works. Mr. Warren then told them it was wasteful to use small coal. He (the speaker) was allowed to give the matter a test during last year, and found he got no more gas from the large than from the small coal; while the time required for burning off the large was quite as long as that needed for the small. On the other hand, the coke from the small coal was more saleable than that from the large coal, as it was not easy to get men to break the large coal into small enough pieces. He put into retorts in July last 28 cwt. of fine coal, and produced from it 15,900 cubic feet of gas, equal to 11,356 cubic feet per ton, using two retorts and charges of 3 cwt. in each retort. The next day he put in 30 cwt.—namely, 9 cwt. of fine and 21 cwt. of rough—and got 16,400 cubic feet of gas, equal to 10,934 cubic feet per ton. The charging in this case was 2½ cwt. in three retorts. The heats on the two occasions were about equal. Next day he took all rough coal, 30 cwt., with 2½ cwt. charges, to a bed of three retorts. From this he got 16,200 cubic feet, equal to 10,800 cubic feet per ton. His experience therefore showed him that the fine coal was really better for his purpose. He might say they had no exhauster; and the pressure on his retorts at the time of making the tests was a little over 5 inches on the ascension pipes. Th coal was Newcastle; and both the fine and the rough came from the same colliery—at any rate, both samples were supplied by the same people.

Mr. WARREN asked how long was the charge in that resulted in 11,356 cubic feet per ton.

Mr. BEAN replied that there were 3 cwt. charges of the fine coal; and they were in 6½ hours.

Mr. T. LORD (Geelong) asked what was the inside measurement of the retorts.

Mr. BEAN replied that the measurements were 22 in. by 14 in. by 9 ft. long.

Mr. S. MARSH (Mentone) said that, as regards large and small coal, he had had a rather opposite experience. About three weeks ago, their contractors notified them that they could not send any small coal; and he was therefore obliged to take two trucks of large. With the large coal he averaged about 400 cubic feet per ton more than with the small; but he could not get 2 cwt. to work off in less than seven hours. The average of the small coal was about 11,100 cubic feet, and of large coal 11,500 cubic feet. His retorts were about 14 inches round. He had no exhauster; and the pressure was about 5 inches.

Mr. HAWLEY (Brighton) said that he did not see the necessity of an export duty on coal. They would only turn round and make them pay for the export; for they would have any way to go into the world's market, where they would have to compete with England and other places. As to stacking, the best way was for every man to stack his own coal. He did not think that the rise in prices was against them altogether. If it handicapped the gas industry, it also handicapped the electric light companies. The electric people had to burn the whole of their coal; gas people got the residuals. The question with them was not so much the price of coal as what it panned out. He had always found that the higher the price of coal the better price the gas companies got for the coke. When he was paying 30s. per ton for coal in New Zealand, he was getting 50s. a ton for the coke. He could not understand small coal paying as well as large. He used both. His contract was usually small screened. He could burn off large coal in about three hours; while it required at least four hours for small, and took more coke to carbonize it. If they could get their small coal considerably cheaper, it might be an advantage to use it; but unless they could do this, it was of no advantage.

Mr. P. C. HOLMES HUNT said Mr. Warren had brought forward a paper dealing practically with but one side of the question. The point that struck him about the coal supply of Australia was that there was practically only one district in which they could obtain coal; and, so far as he could see, this must be always more or less a handicap to the gas industry in Australia. If they could not in any other district than Newcastle obtain coal of the kind they wanted, they could not get competition; and competition was excellent for business. The author had asked them if they kept sufficient stocks, and whether they provided sufficient shelter. He took it that Mr. Warren considered they did not; but he inferred from this that both these points wanted looking after at Mr. Warren's works. These were matters that each manager must look after for himself. It appeared to him, in regard to the cost of coal, that the proposed amalgamation of the gas companies for getting supplies might not bring about the required result. He could conceive of a difficulty straight away, and that was, Were they going to get all the gas companies of one mind in regard to the particular class of coal that they wanted to carbonize? If every gas manager was going in for small coal, for instance, he thought there was a very grave doubt whether he would get it. It was not made in the quantity many people imagined, and there was not a large supply available. Another thing to bear in mind was the quality of the small coal. This did not appear to be regular. Small coal produced in the cutting of large coal might be legitimately described as small; and provided it was not unduly exposed to the weather, he did not see why it should not give a good result. But if the small coal was roofings, scrapings, and dust more or less, they were not going to get the same results as from good small coal. Regarding the supply of coal, of course, what they in Victoria would like to see was an independent coal supply—a good gas coal produced in their own State. He was sorry to say, however, that, from the information he had been able to get, it appeared that geological conditions did not point to such a possibility coming about. He thought Mr. Warren might have gone a little further and indicated some other means of meeting the increased price, apart from the suggestion as to forming an amalgamation. Carbonizing methods had not stood still during past years. One speaker had mentioned 11,400 cubic feet of gas per ton having been obtained, he thought, from small coal, with 5 inches of pressure on the retort. This was excellent working. He could only say that these results sounded decidedly ephemeral, and might be better appreciated if maintained for a long period—say, 365 days, instead of one.

Mr. BEAN remarked that they had sold 10,300 cubic feet per ton, and made on an average 11,500 cubic feet per ton for six months out of small coal.

Mr. AIRD (Townsville), being invited to speak by the President,

said at present he was using three kinds of coals—Stockton, "A.A.," and Hepburn. His experience was that these were the best that could be procured in Newcastle for gas making. It behoved them, he thought, to try and find a coal supply elsewhere. Newcastle coal could not last for ever. He did not mean that they should necessarily go away from the district of Newcastle exactly—there was splendid coal between Maitland and Singleton. If they all used coal from one pit, it did not encourage the coal companies to open up gas-coal elsewhere. In reference to the quantity of gas that could be produced per ton of small coal and per ton of large coal, he used only small coal; and he supposed it would surprise some of them when he told them that his average make was 12,000 cubic feet per ton. But they had to take into consideration that he was in North Queensland, where the climate was hotter; and in a hot climate a ton of coal would produce more gas than in a comparatively cold one. Mr. Warren had mentioned the idea of gas companies amalgamating so as to buy large quantities with a view to getting coal on better terms. With them, on the last contract of 3000 tons, they saved 1s. per ton. If gas companies were to combine and get a mine and provide their own coal, he thought they would find there would be a great deal of trouble in it.

Mr. THOMAS LORD (Geelong) said every company ought to have a store of coal, and convenient storage for it. He was quite with Mr. Warren there. At Geelong, he had storage for about 2000 tons—six months' supply. As to the question raised in reference to small *versus* large coal, he was certainly in favour of the round coal. He had two very practical experiences in the present year with small coal. One lot was very good, turning out almost as good as the round coal. He found, however, that it was very difficult with the heats he was working at to keep the ascension pipes clear; but so far as the production of gas was concerned, it was almost equal to the other. As to the second consignment, he felt sure that there was at least 25 per cent. of it that was not worthy of being called coal of any description. Because this sort of thing happened, he was not in favour of small coal unless it was guaranteed to be the screenings of the coal that was lowered into the boats. Then, again, with respect to residuals, they wanted to get a coal that was a good gas maker, and would also produce good residuals—first-class coke and tar. In some of the small works, the residuals were not of much consideration; but they had very little coke to spare, more especially in the summer months. They did not want a coal that was going to produce a large volume of gas which would take half the profits to purify, but one that would give a large amount of fairly clean gas and a good sound coke for any purpose, and not the sort of coke that would tumble to pieces. He had been using nothing but Stockton "A.A.," and Hepburn coals for some years. The returns for residuals during the last five years averaged 9s. 6d. per ton, which showed that it was worth their while to look out for a coal that would give them a good return in residuals as well as in gas.

Mr. TIPPER (Fitzroy) asked Mr. Lord his make per ton of small coal.

Mr. LORD said that in the first place he was getting 11,000 feet, and on the second consignment of small, about which he spoke, he only obtained 9300 feet.

Mr. WARREN, in replying on the discussion, said they were the sufferers by the raising of the price of coal, and by duties going on. Mr. Bean had told him that it cost about 34s. to get his large coal on to his works. He could only repeat what he had said last year. From there to Bendigo it cost 9s. per ton carriage; and this was the price in the Metropolis for 2000 feet of gas. If the Manager at Bendigo could get 11,000 cubic feet of gas out of round coal as compared with only 9000 feet out of small, he would indeed be very foolish not to make up his freight by failing to use the round coal. He never introduced the question of large or small coal into his paper. Perhaps the greater part of his experience of small coal would, in round figures, be represented by a product of 9000 cubic feet per ton; whereas the large coal would come up to from 9700 to 10,000 feet. He would have liked to have seen debated to a greater extent the question of getting their own coal supply. Mr. Aird had mentioned two Queensland Companies who had amalgamated for this purpose and were getting 3000 tons at a time. Could not they together manage to arrange something of this sort? They could get a piece of land centrally situated at Geelong or elsewhere; and on any gas company writing for a supply it could be sent on from there. By this means they would be sure of a supply always, and would get the coal at a lower price, while allowing for the miners and others concerned being well paid. The last words that he used in his paper were that such arrangements should be made consistently with giving every man a fair and honest price for his work. They wanted security against sudden rises in the price of coal. They had come to the end of November, and there was a rumour that more money would soon be wanted for coal; and the mine owners expected them to provide for it by raising the price of gas.

The Committee of the Manchester District Institution of Gas Engineers ask us to intimate to the members who purpose attending the meeting of the parent Institution in London in June, that, in view of the influx of visitors to the Metropolis consequent upon the holding of the Franco-British Exhibition, it will be advisable to secure rooms at an early date. The reminder may possibly prove useful to members of the other Provincial Associations.

REGENERATOR FURNACES FOR SMALL WORKS.

A paper on the subject of "Regenerator Furnaces for Small Gas-Works" had been promised by Mr. BURALL, of Warrnambool, for the meeting of the Victorian Gas Managers' Association, at Melbourne, in November last. Unfortunately the author had been unable to complete it, and could not attend the meeting. The Council, therefore, decided to open a general debate upon the question.

Mr. FIGGIS (Ballarat), in opening the discussion, said they were well aware, of course, that nothing that could be brought before a meeting of gas managers was of more importance than this question. The matter of the best and cheapest method of carbonizing was one that occupied the minds of all connected with gas companies. He had had a great deal of experience in the matter of regenerative furnaces. The President had reminded him that more than 21 years since he first saw him at work on them. Since then they in Ballarat had used no other form of carbonization, though they had different types of furnaces. He remembered in the early days it was looked upon as a matter of great difficulty to use a single furnace by itself. It was generally conceded that it was necessary to have from four to six working together in order to get the best results. However, he had started with one—namely, a Siemens furnace. Siemens was the initiator of this system. In those days, there was no grating to the furnaces; the coke being dropped to the bottom of the furnace, which was circular in form. Since then innovations and improvements had been made; and they had been legion. He thought that among the smaller gas companies it was considered that the use of the generator furnace was out of the question; but it was pleasant to know, from the statements that had been made to them that morning, that there were now many small works in Victoria that were using generators, if not regenerators. Of course, they all knew that with generators there was no means of heating the secondary air. While he thought that good results could be secured with a small generator, he considered that, if possible, it was very good to add a little regeneration. It did not follow that they would require many generator flues; they could add one or two or extend them as far as they liked. Some of the more elaborate systems had eight or ten flues on each side of the furnace heating the secondary air. They must remember in heating the air a lengthy travel was not necessary; and after an experience of 21 years, he must be pardoned for saying that if they put in flues for regeneration they should make them as simple as possible. They lived in a land where it was difficult to get fire-brick fittings at a fair price. They had to order them from England, and they got broken in transit. Another point to remember was that the more elaborate the regenerator flues the greater difficulty there was in keeping them clean; so that he thought simplicity should be one of the chief considerations. There was a matter about which he was speaking to some of his friends that morning that should be mentioned. This was the rule-of-thumb method which at present obtains regarding the size of the nostril holes for the producer gas and secondary air. He would be glad if some of those who had extended experience with them would give them their results. Without doubt, he thought they would find that all who had tried the generator or regenerative system would pronounce it a very great saving in labour in the arduous work of the furnace man; while production was more under control, a decided saving was made in coke, and, if properly worked, they could give a higher degree of heat to the retorts. These points were considerations, and would doubtless be threshed out in discussion. In small up-country works, he believed it was customary to damp-down the fire and shut up for an extended period when the consumption was low. With a generator or regenerator furnace, this could be done to a nicety. They could shut them up so that they would consume little or no coke.

Mr. HAWLEY (Brighton) said he had regenerators installed, and he provided for just a slight heating of the secondary air. He heated it by running it through the cavity in the back wall. The first regenerator that he put in was in 1884. It was placed in the floor of the retort-house, and worked splendidly. When he came to Brighton, he put in three regenerators there, of five retorts in a setting. He had 7 ft. 8 in. of retort exposed to the furnace, and found that he could turn out 75,000 cubic feet of gas per day with ten retorts. Taking the exposed surface of the retorts, he obtained an average of 1000 cubic feet per foot. He had tried all sorts of plans. Instead of having the furnace at the bottom, he had it up the centre of the arch, and the retorts on each side of the furnace. He had never been in a position to build in a new furnace, but had always to adapt his plans to existing arches. He had the furnace at the top, and at least 6 feet depth of furnace; and it worked very well. The secondary air came up the back wall. In the last one he built, he made a cavity even in the front; but with this one he had the misfortune to do the same thing as he had done in Auckland. Within a week he had the bottom of a retort burnt out, and had to put tiles in the bottom to go on with. This was due to the high temperature through the perfect combustion of fuel. Ever since he had put this lot in, he had had naphthalene trouble; so that in building other ones he would certainly modify them so as to bring the heat down, and not up. He was quite satisfied from his own experience that the high heats were the cause of naphthalene—more particularly when the

charges did not get properly planted. If a man understood the secondary air, it was easier to get the heats lowered with the generator than by ordinary firing. He had heard people condemn them; but he would advise every manager to put in a little generator. In Gippsland, where he had a small consumption, he paid a 10 per cent. dividend from the start only through putting in a generator and himself stoking night and day. The advantage was that one could shut them down and go away for hours, and they were all right.

Mr. BEARUP (Hamilton) asked if Mr. Hawley thought that they saved coke.

Mr. HAWLEY: Yes; but, of course, it is just as easy to be wasteful with a generator as with any other method.

Mr. TIPPER (Fitzroy) said that, so far as his views went regarding regenerative furnaces, he was not sure whether they were generators or recuperators. He admitted that the Vice-President had defined the difference between the regenerative furnace and the generator; but he was not sure whether he agreed with him. He thought they were all in a measure regenerative, and certainly gaseous. He considered that every gas-works, no matter how small, should possess a gaseous-fired furnace. He did not quite follow Mr. Hawley, and was inclined to think that it would be a very bad setting in which the bottoms of three retorts would fall out in three days. He had seen many regenerative furnaces, but never one that could be got too hot if properly built. There were certain principles that governed gas-firing which he thought should be well attended to. They should know they were trying to generate carbonic oxide, and trying to introduce the secondary air so as to cause complete combustion. If proper arrangements were made, the furnace could never get too hot, unless they had local heating through the whole of the carbonic oxide setting up a terrific heat in one place. But if they had a perfectly-diffused carbonic oxide meeting the incoming secondary air at a number of points, they could not get local heating. To his mind, it was almost impossible, with anything like care, in a perfectly-built small setting, to melt the retorts. His experience of generators in small works was that they were far less trouble to the men and the managers than the ordinary open fire. They required less attention when once the fire was set, and they did not vary much when once the secondary air was adjusted to suit the primary. Of course, if a man knew how to manipulate it and open up and shut down the secondary air and increase and decrease the primary air, he could get all manner of results; but with regard to the heating of the secondary air, he did not think it was a good thing—the more heat they could take out of the waste gases the more economical would be the furnace. He took it this was the point where the economy was effected, in the utilization of the heat that was going up the stack—absorbing it by heating the secondary air. It was quite plain to him that it was worth considerable trouble to take all the heat one possibly could from the waste gases. This was the great object of the regenerative setting—the great economy in fuel. Of course, where they were only partly employed—where there was no banking-up—the setting could not be used to its full advantage; but where it was in continuous use, there was a very great saving in the coke. In some works, they sold as high as 11 cwt. of coke per ton of coal; while there were very few works using open firing that sold more than 6 cwt. He thought it was a wonderful thing if they could double the amount of coke made for sale, particularly when a hundredweight of coke was worth 1s. With regard to the principles to be adopted for heating the secondary air, in the early stages they had the most complicated settings, beautifully arranged and very costly; but these had given place to simple arrangements. There were really only two systems now in use. The one was a flue of secondary air sandwiched as it were between two waste gases, and the other was a simple arrangement of the secondary air rubbing sides with one of these waste gases. But in every case it was a very simple setting, and most effective; the main object being to take as much heat as possible from the waste gases. The more heat they could take from the waste gases, the nearer perfection they would get, and the greater would be the economy of fuel. With regard to the difference in the heats obtained by generator firing and the old open firing, he did not think it was great; but he knew that the heats derived from the system of gaseous firing were more steady. They did not fluctuate in the same degree as the heats derived from open firing, for the simple reason that there was a greater margin of fuel below. Mr. Hawley had mentioned a deep-fuel pit. To those who had read the great trial of Graham, Morton, and Co. *v.* Compagnie l'Union des Gaz, it would be no news that some leading engineers considered 2 feet of fuel quite sufficient.

Mr. FIGGIS: That is, if kept full.

Mr. TIPPER replied that this was the minimum. Of course, he thought they were right. Mr. Hunt had carried out some interesting tests with waste gases in the furnaces at Fitzroy, to prove how far combustion was complete; and he found that there was very little difference between the minimum fire, or what would be called a shallow fire, and the full fire. The results were practically the same. The carbonic oxide present and the waste gases varied very little as between the low fire and the full fire; thus proving the adjustments were about correct. Mr. Figgis, in speaking the previous day about regenerative furnaces, said he would be glad if someone would deal with the question of size of nostril. Mr. Figgis said he had had 21 years' experience with regenerative furnaces, and therefore he (Mr. Tipper) was hoping to pick up a crumb on the subject from him in regard to his early failures and recent successes. So far as his experience went in regard to nostrils, they might make them any size they liked; but the larger the better. He was quite certain that any investigation in regard to regenerative furnaces would be well repaid. It was the key to good carbonizing.

Mr. BOWMAN (Sale) said that the gentlemen who had spoken had not mentioned anything in regard to the question of using steam with the fire. He would be very glad to get information on the subject, as to its necessity or otherwise.

Mr. HAWLEY said that the melting of the retort was not due to too low a heat, but to perfect combustion. He did not see how they could get a high temperature unless they had perfect combustion, and a gaseous fire was considerably hotter than an ordinary fire, no matter how it was treated. As to heat being local, it was not so. Mr. Tipper had asked what sort of setting his was. It was a good setting; but his experience was that every change of the wind caused a variation of the furnace. If a strong wind was blowing, there was a bigger draught. On the other hand, every variation of the fuel made a variation of the draught; and it did not matter how one regulated it. The conditions were continually varying through the wind, or the draught, or the kind of fuel in use. As to having 2 feet minimum, if they had 2 feet minimum and worked to it, how long would they have a fire? At Brighton, the furnaces were fired four times in 24 hours; and then they swept up the retort-house floor and everything went in. The better class of coke, however, was wheeled out. The fires were about 2 feet deep when they clinkered. They had 2 feet of clinker to take out; so he could not work his with a 2 feet minimum. They clinkered once only in 48 hours, and then they could take out the clinker with their hands—it was quite cold. He could not possibly get that if he worked with a shallow furnace. In some cases they only clinkered once every three days.

Mr. BEAN (Wangaratta) said that his works were exceptionally small. A bed of three was quite big enough for their winter's make, and it was rather too big for the summer make to be economical. He had a bed of three set in a small generator, not regenerator. The secondary air was taken along the side of the furnace by the side of a 9-inch wall. The reason that the wall was 9 inches thick was to make it easy to re-line the furnace. There were four air-passages to each set 9 inches deep and 4 inches wide. The upper part of these air-passages was brickwork, 3 in. by 4½ in. wide, dropping down as a buffer to cause the air to come in contact with the hot brickwork.

The PRESIDENT said the point was the adaptability of regenerative furnaces to small works in the matter of minimizing labour; and he asked the speaker how he found them in this respect.

Mr. BEAN said they were a very great economizer of labour; and there were a few points to be considered that made them even more economical. One was that the fuel doors should be easy to operate by being well fitted. They should be well insulated from the heats of the furnace, so as to be kept from twisting. The clinker doors should be of good size and easy to actuate, and the water arrangements should make it easy to take the water in and out for the clinker. He did not use steam; but he thought that it would be preferable. They clinkered once in five days; but they had not sufficient demand for the gas to tax the furnaces, so they could not take what he said as a fair test. More clinkering would, of course, be required if the furnace was worked harder.

Mr. AMBROSE (Heidelberg) said six years ago he put in a small generator and effected a saving of 25 per cent. in fuel. His retort-house was facing north and south; and he had to regulate the secondary air according to the way the wind blew. From the start he had great trouble with naphthalene. Three weeks ago also the pipes were thick with naphthalene. He then started using Hepburn coal, and they got quite clear. Afterwards, he used the ordinary Newcastle coal, and the naphthalene came back again. The Hepburn coal used was small. The coke and tar from this coal, however, was much less than from the ordinary coal. The Maitland coal seemed to burn very clear, and the coke was softer than the Newcastle coal coke.

Mr. WARREN (Footscray) said he would like to know something of the cost of altering a furnace to the generator system, and whether a furnace was adaptable to the system without pulling down the bed. Some eighteen years ago, when generator furnaces were established all over the world, he wanted to be up-to-date and get one. Unfortunately for him, however, his works were situated very low down, and the water from the river overflowed, and he found himself unable to carry out the work. But he was now about to build another bench of retorts on ground that the Board of Works had run a main sewer through, and the street was properly graded to take off the flood waters.

The PRESIDENT said that installing five retorts at Box Hill—exclusive of rebuilding and putting in a generator—cost £75.

Mr. HOWLETT (South Melbourne) said that undoubtedly regenerative furnaces in small works were a great success; but unless the benches were thoroughly well constructed, things did not work well. As Mr. Tipper had pointed out, there must be no bye-passing; and the nostril holes must be thoroughly looked after. So if members in the country wanted to construct generator beds, it was necessary to employ thoroughly able workmen to put them in. As to nostril holes, he agreed with Mr. Tipper that they could not be too large. There was no doubt that one must be a good deal guided by the construction of the bench as to where one placed them, and also as to the size.

Mr. FIGGIS remarked, in regard to what Mr. Tipper had said, to the effect that the nostril holes could not be made too large, that a very long discussion took place on this point years ago. Many engineers used one nostril hole and two secondary air holes; others said there should be two rows of holes round the arch; and others again used a central row of holes. There seemed to be no generally fixed idea in the minds of engineers on the subject. The manner in which these holes were put in was by no means satisfactory; and it was a great pity that something more definite was not known. The proportion of the holes was another thing that needed to be more definite. There should be an understanding come to as to the size of the ends and the size of the gas holes.

Mr. AIRD (Townsville, Queensland), on being invited to speak, said that in his works he had had no experience at all, because he had been placed in the same position as Mr. Warren at Footscray. When he took charge of the works, the retorts were so low that it was nothing new for a high tide to come in and not only put out the furnace, but get inside the bottom retorts. So he was satisfied it was no use thinking about putting in a generator for the time being. But as soon as opportunity permitted, he built three beds of six retorts at the end of the others, and took the precaution of putting in a foundation that would carry a furnace later. On the point as to whether or not regenerative furnaces were adapted to small works, he might say that he was on several occasions called upon to pay a visit to a small works 150 miles away, at Mackay. There they had a small furnace working for seven years without any repairs of consequence. Their output at that time was from 15,000 to 17,000 cubic feet of gas per day from three retorts. In his report, he recommended that the benches be overhauled. To do so, it was necessary to light up a bench of five retorts by direct firing; and during the period the other furnace was under repair, it took them all their time to keep the town supplied with five retorts doing the same work as the three had done with the use of a generator furnace. He was quite satisfied that the use of a generator furnace was therefore a success in small works, provided it was properly built and got a certain amount of attention. It was a success in that it saved both labour and fuel. The fuel saved in the Mackay works was something like 25 per cent. When they were working the direct-fired furnace there, they could not make sufficient coke; and he had to send some from his works to help them. Although he could get just as good a heat from direct firing as by the other way, the economy in the use of the generator came in the saving of labour and of coke. The five retorts they used at Mackay for direct firing were just the same size as the three used with the generator. In small works, however, one could not possibly get the same heat as in large works. Most of the fires were banked up at night time. At Mackay, they only filled the furnace twice a day; and the man making the gas was fitter, manager, and also the lamp-lighter. When he had put in the charge, he could go up town to attend to other matters. He ran the whole show; so the generator furnace was of great value to him. When direct-firing was practised, a man had to be in attendance at the furnace all the time. He (Mr. Aird) hoped yet to get a generator in his own works.

Mr. P. C. HOLMES HUNT (Melbourne) said he would be glad of information as to the minimum size of the works that were adaptable for regenerator furnaces. He could not quite agree that a works which was running three or four retorts and making about 2 million cubic feet of gas a year was entirely suitable for the adoption of gaseous firing. It appeared to him that it was necessary to arrive at a unit as it were; and the unit would probably be the number of retorts—say, three or four—which they could keep going all the year round, so as to get the full benefit of the regenerator setting. It appeared to him it was a point which they should clear up. There must be a limit.

Mr. BEAN said his make was 3¼ millions. Four years ago, when he used the ordinary firing, it was 2½ millions. They had to use in the winter a bed of two and a bed of three—namely, five retorts; and it took them all their time to make sufficient gas for the winter's demand. Now, with a generator, a bed of three was quite enough for them. They also had a surplus of coke for sale, while previously they had very little indeed. With regard to the size of works suitable for a generator, he did not think that one should ever be put into a gas-works having less than a bed of two retorts.

Mr. FIGGIS said there seemed to be a consensus of opinion that generator or regenerative furnaces were a good thing for small works. One point, however, that had been missed by most of the speakers was that there was a great saving in the wear and tear on the retorts.

Suction Gas as Motive Power in Australia.—According to a report which came to hand by the last mail from Melbourne, there has been installed at the Gordon Gold Mines suction gas plant for furnishing the motive power for battery purposes. This is the first occasion on which this power has been employed in this connection in Australia. The Company have a mill of 15 heads of stamps, and they are run by an 18 H.P. gas-engine. So far the fuel consumption has been at the rate of 26 cwt. for 144 hours; and the manager of the mines considers the difference between the cost of suction gas and steam will be in the proportion of 30s. to £7.

ENGINE INDICATORS.

At the last Meeting of the Association of Engineers-in-Charge—which was held under the chairmanship of Captain H. Riall Sankey—a paper was read by Mr. W. A. TOOKEY, on "Indicators and Indicator Diagrams."

It was a lengthy, as well as an interesting, contribution to the Association's proceedings; and its value was considerably enhanced by the inclusion of a number of illustrations of different forms of apparatus. The author turned his attention rather to placing before the members some practical hints on the selection and manipulation of indicators, than to giving a history of their development, or a scientific study of the diagrams they enable the engineer to obtain; and that his efforts were appreciated was manifested by the complimentary remarks of the Chairman and others at the conclusion of the paper. An accurate diagram, Mr. Tookey remarked, implies (1) that the vertical movement of the indicator pencil exactly accords with that of the indicator piston throughout the diagram, and that the piston movement exactly registers the prevailing internal pressures within the motor cylinder; and (2) that the horizontal movement of the indicator paper exactly accords with that of the motor piston throughout its stroke. It was under these two headings that the paper was divided; and the author dealt in turn with the particular details which need to be considered by those entrusted with the task of indicating engines of various types. An indicator, explained the author, is nothing more than a pressure variation recorder. A piston of known area is provided within a cylinder, and is attached to a carefully calibrated spring. The piston is exposed at will to the working pressures existing in the motor cylinder. If the pressure is greater than the resistance of the spring the piston moves upwards, or if less the piston moves downwards.

In the course of dealing with the first part of his subject, Mr. Tookey pointed out that, under the conditions in which ordinary indicator tests are made, the diagrams obtained are comparable only with others taken from the same engine and under similar conditions. To use the indicator as a scientific measuring instrument, delicate enough to enable comparisons to be made between different engines, is impracticable. Yet many experimenters have recently given results of tests made with indicators applied to engines of varying sizes, and have endeavoured to institute comparisons from the calculated results as to the respective merits, based upon diagrams taken from dissimilar positions, with varying lengths of connecting tubes, and probably with apertures of dissimilar and irregular cross-sectional area. Seeing that the working fluid in steam and gas engines is much more elastic and not nearly so incompressible as water, the indicator as usually applied cannot reliably record every slight variation of cylinder pressures. Too much reliance, therefore, should not be placed upon the indicator as an instrument of precision. It is, without doubt, a very useful appliance for comparative readings; but the diagrams obtained may be safely compared only with others taken from the same engine, and be taken as being accurate only within (say) 4 or 5 per cent.

While describing the various forms of apparatus, Mr. Tookey gave particulars and illustrations of the optical instrument invented by Mr. Dugald Clerk and used during his well-known experiments upon specific heats of the working fluid in cylinders of internal combustion engines, which were made public in a paper read before the Royal Society in March, 1906, and noticed in the "JOURNAL" for May 22, 1906 (p. 516). The piston is attached to a spring in the usual way; and a chain is used in place of a piston-rod, which is attached to one arm of a beam. The other arm is attached by a similar chain to a spiral spring, to keep the connection between beam and piston taut. Upon the spindle of a beam, a silver mirror is placed; and in order to obtain quite a small spot of light, the mirror is convex and silvered on the front instead of the back as is usual. The light is projected on the mirror through a pin-hole from an arc lamp; and the movement of the spot of light is projected against a piece of sensitized photographic paper held in a sliding frame. The paper is curved in such a way as to be proportionate to the concavity of the mirror; and thus perfect reproduction is secured. The horizontal motion is obtained by means of a rigid rod moved by a pendulum attached to a link in the piston; and thus the horizontal movement coincides with that of the piston. The lines obtained are very thin, clear, and definite, without any shake or vibration. It would, the author said, be evident that the results obtained with such an indicator are much more accurate than can possibly be claimed for any pencil indicator. The optical indicator, however, he contends, is unfitted for ordinary commercial uses; and it will be many years before the pencil indicator is entirely superseded. Whatever its inaccuracies, it is undoubtedly convenient; and, being mainly used for comparative results to record derangements of valve gear, &c., and to give approximations of power developed by the working fluid, it is sufficiently accurate for commercial and industrial purposes.

On the author resuming his seat, a hearty vote of thanks was accorded to him, on the proposition of Captain Sankey, seconded by Mr. H. Capsey, the Hon. Secretary, who remarked that if an indicator could only be given to them in such a form as would furnish undeniable evidence as to what was taking place within the walls of the cylinder, it would be very valuable. Several of those present subsequently discussed the paper.

REMOVAL OF ARSENIC FROM GAS COKE.

Before the Royal Scottish Society of Arts, on Monday evening last week—Mr. W. Allan Carter, of Edinburgh, presiding—the following paper on "Arsenic-Free Gas-Coke," prepared by Mr. HENRY O'CONNOR, F.R.S.E., and Dr. DRINKWATER, F.R.S.E., both of Edinburgh, was read by the latter.

About the middle of 1901, a Commission of experts, consisting of Sir Lauder Brunton, Dr. Stevenson, Mr. Alfred Gordon Salamon, Dr. Luff, Dr. Samuel Buckley, and Mr. J. Fletcher Moulton, K.C., was appointed by the Manchester Brewers' Central Association to investigate the causes of poisoning by beer. The section of their report referring to coke was as follows:—

When malt is contaminated with arsenic, the malt culms and kiln dust contain a much larger proportion of arsenic than the malt itself. This is accounted for by the fact that when the green malt is loaded on to the kiln, and subsequently during the kilning, the physical structure of the culms renders them particularly liable to absorb any arsenious vapour that may be carried to the malt as the result of combustion of contaminated fuel, and that this liability is increased by the fact that from their position, relative to the malt, they are more exposed to the heated air. Our investigations have shown that the contamination of malt culms and kiln dust is chiefly due to the use of coke, and especially of gas-coke. Inquiries made of the principal maltsters in England have elicited the practically unanimous opinion that there is no necessity whatever to employ gas coke in the preparation of malt. Nor, indeed, is there any real necessity to employ coke at all for the purposes of malting. If the use of coke were dispensed with, a good many malt-kilns would have to be structurally modified; but the brewer would not fail to appreciate the benefits of such alterations. It might be necessary to use a small portion of coke in the drying of amber malt; but in such cases it would certainly be advisable to employ coke made from hand-picked and washed coal, and not gas coke. We recommend, therefore: (1) That the maltster be required to give a guarantee to the brewer that he does not employ gas coke in the preparation of his malt. (2) That the malt culms be regularly tested for the presence of arsenic. (3) If the culms be found to contain noticeable quantities of arsenic, that the kiln dust be at once removed, and the fuel employed be further examined for arsenic. That, wherever possible, the best possible anthracite be employed for malting purposes.

That there was every reason for the appointment of the Commission is evident from the fact that there was exceptional sickness and death at the end of 1900, attributable to arsenical poisoning, chiefly affecting the districts in Lancashire and Staffordshire. Manchester suffered most; the number of cases in the county boroughs of Manchester and Salford alone being put at 3000. It was not until November, 1900, that arsenic was indicated by Dr. E. S. Reynolds, of Manchester, as the cause of the epidemic sickness in the city. The beer then in consumption was tested, with the result that arsenic was found in dangerous proportions in a large number of samples. When the beer was withdrawn from sale, the epidemic came speedily to an end.

At the beginning, the arsenic scare was founded not upon the amount in the coke but that in the sugars used. It was, however, noticed that there were other sources of contamination with arsenic; and these were principally due to the fuel employed in drying the malt, which at that time consisted largely of gas coke. One firm of maltsters in Harrogate took about 3000 tons yearly; and this use of coke had to be entirely abandoned at that time. It was the knowledge of this fact that led to our experiments to eliminate the arsenic, and to again make this fuel satisfactory for malting purposes. Lime was first tried, with the result that the arsenic was rendered non-volatile and fixed in the coke. This did not get over the difficulty, as the coke dust in the kiln contained arsenic, which it was pointed out in the report was objected to, as it plainly indicates that the kiln dust is a source of contamination. At this point it might be mentioned that the amount of arsenic found in coal and coke is not large. Another point which might be noted is that the arsenic found in the original coal is nearly all left, after carbonization, in the resultant coke, showing that the usual process of retorting has little or no effect in reducing this impurity.

From tests we have made, we give the following figures, showing, in grains per pound, the quantities of arsenic as arsenious oxide found in coals and cokes: Scotch coals—No. 1, 1·03; No. 2, 0·98; No. 3, 0·99; No. 4, 0·76. English coals—No. 5, 0·88; No. 6, 0·98. Welsh anthracite—No. 7, 0·02; No. 8, 0·86. Gas cokes (ordinary)—No. 9, 0·74; No. 10, 0·65; No. 11, 0·91. It seemed, therefore, that some method of volatilizing the arsenic during the process of manufacture of the coke would be the best, if not the only, way of solving the difficulty. Hydrochloric acid was passed over hot coke which was found to completely eliminate the arsenic. It was obvious that this process could not be used on a manufacturing scale, on account of expense and corrosion of any metal work; but it afforded a clue as to the method likely to succeed. We therefore turned our attention to volatile chlorides which would themselves provide the chlorine gas required to combine with the arsenic and form a volatile compound.

Experiments on a small scale with common salt were successful; but not to the extent that was found with the hydrochloric acid. We then had an opportunity of trying the experiment on a manufacturing scale in the vicinity of Edinburgh. A rough calculation of the amount of salt required per ton of coal showed that 2 oz. would be ample. This was allowing for a considerable loss in salt which was bound to occur. The result showed that, whereas the coal contained 1·66 grains of arsenious oxide (As_4O_6) per pound, the coke prepared in the laboratory from that coal untreated gave 0·83 grain per pound, while the coke from the same coal, but treated with salt at the gas-works, gave 0·0055 grain only. "This, though more than good anthracite coal contains, is, of course, infinitely better than gas coke averages, and is about the same as oven coke of the best type." This was the opinion of a practical maltster. We might point out that the figure given—viz., 0·0055 grain—was the total arsenic present, both fixed and volatile. It was pointed out to us that it would be necessary in future work to distinguish between the fixed and volatile forms. It occurred to one of us that a more intimate mixture of salt and coal, and one which would be more easily applied, would be obtained by merely sprinkling the coal with a solution of salt in the proper proportions. An experiment on these lines was carried out in the gas-works, with the following results, in grains of arsenious oxide per pound: Coal, 0·99. Coke, volatile, 0·0057; fixed, 0·002—total, 0·0077.

These results were somewhat disappointing; and we think they are accounted for by the moisture carrying off some of the salt before it had acted on the arsenic. We therefore returned to the use of dry salt. At this stage, it was thought advisable to send duplicate samples to a brewing chemist; and the comparative results were as follows:—

Untreated Coke.		Treated Coke.	
A. . . .	0·0357 grain volatile.	A. . . .	0·0024 grain volatile.
B. . . .	0·0400 ,, ,,	B. . . .	0·0030 ,, ,,
A. . . .	0·0143 ,, fixed.	A. . . .	0·0143 ,, fixed.
B. . . .	0·0140 ,, ,,	B. . . .	0·0120 ,, ,,

As regards the series of analyses marked "A" of the treated coke, the chemist reported that "this coke was about the average of the best anthracite."

A further experiment was now tried as to the effect of a mixture of lime and salt sprinkled over the coal before retorting, using 8 oz. of each to the ton of coal. The results (grains) as found by the brewing chemist showed: Untreated coke (A), 0·007 fixed, 0·013 volatile; treated coke (A), 0·012 fixed, 0·002 volatile. This shows that the fixed arsenic is slightly increased, while the volatile is considerably decreased. The use of the mixture showed no improvement over the use of plain salt; in fact, the fixed arsenic appeared to be increased. Being anxious to try the effect of other chlorides, we substituted calcium chloride for the salt in another experiment, with these results (in grains): Untreated coke, 0·013 fixed, 0·067 volatile; treated coke, 0·016 fixed, 0·011 volatile.

We now submitted samples of our treated coke, made in the gas-works with the use of salt only, to Dr. A. K. Miller, of Manchester, who is an accepted authority on arsenic in coke (without giving him any information as to the origin of the coke); and his report states: "I have carefully tested for arsenic the sample of coke received from you on the 8th inst.; and I find that it contains approximately 1-35th of a grain of total arsenic, calculated as arsenic trioxide, per pound; volatile arsenic, *nil*." [1-35th of a grain is practically 0·028 grain.] On informing Dr. Miller of the origin of this sample, he again wrote: "If the coke was originally anything like the samples which I am in the habit of analyzing from this district and Yorkshire, your treatment of it has certainly had a remarkably purifying effect."

The patent was applied for and granted entirely free from any qualifying clause or reference to previous patents. The process is now in operation; and, in the case of one company using it, supplies of treated coke have been furnished at least nine times to the same firm of maltsters over a period of two months, which clearly shows that such supplies were giving satisfaction. The tests for arsenic are among the most delicate in analytical chemistry; the very small quantities to be dealt with precluding the possibility of weighing. At the time of the arsenic scare, a number of methods of estimating small quantities of arsenic were proposed. As our investigation required the most accurate results, and involved considerable numbers of analyses, it was necessary that the process selected should be at the same time both accurate and quick. One of the earliest methods recommended was to treat the coke with strong nitric acid on a water-bath, and to evaporate until the red fumes ceased. The residue was then treated with concentrated sulphuric acid in a similar manner twice, and the extract Marshed in the usual manner. The repeated evaporation took considerable time, and, as far as our experience went, was liable to contain sulphides which would retain some of the arsenic.

After the Royal Commission had issued their report, the Chemists of the Inland Revenue Department were asked to prescribe a process applicable to all substances used in brewing operations; and, after trying a number of experiments in the Government Laboratory, Professor Thorpe laid before the Chemical Society, in 1903, a very complete set of tests for the examination of brewing materials for arsenic. The only one which really interests us this evening is that portion of the report which deals with fuel. A special apparatus was designed, in which all the glass parts fitted together with ground joints. The process consisted in heating the fuel in a current of oxygen, and collecting the volatile constituents in a vessel filled with arsenic-free acid. The acid liquid containing the volatile arsenic was at once Marshed, and the result gave the volatile arsenic. The residual ash, containing the fixed arsenic, was treated to a rather complicated process. It was placed in a flask attached to an inverted condenser, and boiled with pure hydrochloric acid

containing a little bromine for two hours. It was then allowed to cool, and the excess of bromine removed by means of meta-bisulphite of potash. The liquid was next boiled, so as to expel the sulphur dioxide produced, and was afterwards filtered. The clear filtrate was distilled, and the distillate contained all the fixed arsenic in the form of chloride. It was now evaporated down with a mixture of nitric and sulphuric acids, until the fumes of sulphuric acid appeared; then it was cooled and diluted. As the arsenic was at this time in the condition of higher oxide, it was not suitable for Marshing, and the arsenic was therefore reduced by means of meta-bisulphite of potassium, and the excess of sulphur dioxide boiled off; the residual liquid being Marshed in the usual manner.

This process, though very complete, and undoubtedly capable of giving good results, is open to several objections. In the first place, the heating in oxygen takes at least two hours, and the remainder of the process about another four or five hours. Again, in the case of coal, the heating in oxygen is liable to end in an explosion, unless great care is taken. The next method proposed was to heat the coal or coke with a mixture of magnesia and dry sodic-carbonate; and the residue was dissolved in sulphuric acid and Marshed as in other methods. The magnesia and sodium carbonate in this process retain the arsenic, which is afterwards dissolved in the sulphuric acid.

The success of this process depends mainly on, first, the fine division of the fuel; and, secondly, the gradual heating of the mixture in the crucible. Proceeding in the manner described, it was found sometimes, for reasons which we cannot explain, that the residue contained sulphides; and though this method has, in the main, been used, it has been found convenient to add to it some portion of Professor Thorpe's process. After heating with magnesia and soda carbonate, it is dissolved in purified hydrochloric acid and bromine, and boiled under the inverted condenser as formerly described. The remainder of the process is conducted as in the Thorpe system. The difficulty in all these methods is to procure chemicals free from all traces of arsenic This difficulty was recognized by the Royal Commission; and they give a method of purifying the hydrochloric and other acids used. There is not so much difficulty now as there was at the time of the Commission. Pure zinc can be procured; but one must select the sample, as some forms of zinc are insensitive, for some reasons not at present known. The somewhat cumbrous method proposed by the Royal Commission for the purification of the acid has been given over, and it is simply boiled under a reflux condenser with some copper gauze for two hours; then, after removing the gauze, the acid is distilled. In this way, the faintest trace of arsenic is removed. In using pure zinc in the Marsh apparatus, one frequently finds that the acid has little or no action on it. This difficulty is best overcome by adding a few drops of a strong solution of sulphate of copper, when the action at once commences.

The increasing prices of anthracite coal, due to its use for malting and in suction power-gas plants, renders the question of another fuel one of considerable importance to maltsters. The number of letters which we have received, asking particulars of the process, show that the maltster is quite prepared to return to the use of coke, if it can be rendered non-arsenical.

The CHAIRMAN said he presumed that the paper was so technical that probably few present could follow it, but they could all see that the subject was one of vast importance to a great industry; and if the method adopted by Dr. Drinkwater and Mr. O'Connor had been successful in eliminating—perhaps not entirely, but in a large measure—the amount of arsenic which might be given off by the coke to the malt, he thought they were to be congratulated upon having succeeded in making a great improvement in its manufacture. He did not gather what was the final result of the experiments—whether the inventors had come to the conclusion as to the dry salt being the better thing to use, or a mixture of salt and lime or other chlorides. Perhaps Dr. Drinkwater would tell them what had actually been determined upon as the proper method of working under the patent.

Mr. A. CLARK asked if the process would add materially to the cost of the coke.

The CHAIRMAN said he should like also to know what other fuels were used when the arsenic scare came up.

Dr. DRINKWATER said that at the time of the scare, and when it was found that coke would not do, the maltsters had recourse mainly to anthracite. This was really about the only fuel they could fall back upon, because it contained a very small quantity of arsenic—only about 0·2 grain per pound. One or two seams of anthracite, he believed, were all but free from arsenic. As to the method adopted now, the coal in front of the retort was simply sprinkled with about 2 oz. of common salt per ton. The quantity varied somewhat—depending, to a certain extent, upon the nature of the coal; but the use of from 2 oz. upwards apparently eliminated the arsenic. As to the expense, the members could easily see that it was very small; about ¼d. per ton of coal would cover it. Scotch coke contained a very large quantity of ash, which made it objectionable; but in England maltsters used coke very largely—or they did until they were obliged to drop it on account of the arsenic scare. They could see that by the treatment with salt the amount of arsenic was brought down to a very small quantity indeed.

It was proposed to submit it to a Committee, consisting of Mr. W. R. Herring, Mr. Geo. H. Gemmell, and Dr. Westergaard—Mr. Herring to be the Convener. This was agreed to.

THE "QUESTION-BOX" AT THE VICTORIAN GAS MANAGERS' ASSOCIATION.

One of the features at the meeting of the Victorian Gas Managers' Association, held in Melbourne in November last, under the Presidency of the Hon. GEORGE SWINBURNE, Assoc.M.Inst.C.E., was the "Question-Box." There were several items for discussion; but owing to the limited time at the disposal of the members when this part of the programme was reached, only two of the questions were dealt with at the meeting.

"What is the best method of removing carbon from single retorts, especially from the back of same?"

Mr. Tipper, of Fitzroy, thought the method employed for removing carbon had a very great influence on the life of the retorts, and also upon their condition for a considerable portion of their life. He supposed all of them had tried some way of removing the carbon. One method was to allow the retort to stand off; but it was not a good one. It lead to fracture of the retorts and to bad condition. He thought the very best means was to burn or consume the carbon in a closed retort by supplying it with a current of air, preferably under pressure. Where this was undesirable from a financial point of view, by removing the cap of the ascension pipe and putting a pipe through a special mouthpiece lid, and then closing the lid, they would get sufficient current passing to the back of the retort and away up the ascension pipe to remove the whole of the carbon. The thicker the carbon, the more favourable was this method of removing it. It did not knock the retort or jar the setting. Mr. Bean, of Wangaratta, had used the pipes in the manner explained by Mr. Tipper, and found that the carbon burned off in from five to six hours. The plan Mr. Hawley, of Brighton, adopted was to take the cap off the ascension pipe and shut the lid. The ascension pipe was 5 inches in diameter, and left a hole in the back of the retort about 6 inches in diameter. He did this at five o'clock at night, and by eight o'clock next morning what carbon was not burnt off was free. He only burnt the carbon till it got loose and came away. He tried to save what he could, as he got £2 per ton for it. Mr. Tipper remarked that when speaking he had in his mind the solid-backed retorts; but he thought the idea that Mr. Hawley had spoken of, with brick-backed retorts, was a very good one. When he saw what was done by Mr. Lord at Williamstown, he was struck with the impression that that gentleman's method was the most perfect single-retort system of dealing with carbon he had seen. Mr. J. Lord, of Williamstown, said his plan for dealing with carbon was removing it. He had never tried to burn it off. His retorts were 10 feet long, and had mouthpieces at both ends. Then he had a mouthpiece made especially at the back of the frame, with a door that fitted into it. When removing the carbon, he took the door off and broke the carbon. He got it out in about an hour-and-a-half from five retorts. His objection to burning off was that it took him longer afterwards to fill up the cracks in the retorts than it took to burn off. By his plan, he got it out quite easily; and the cracks still remained full of carbon. Replying to Mr. Krummell, of Warragul, Mr. Lord said that he had about 9 inches of brickwork in front of the cast-iron door. Mr. J. Thompson, of West Melbourne, asked if anyone had tried steam for removing the carbon? By passing a half-inch steam-pipe into a retort, and taking the cap off the ascension pipe, with 40 lbs. pressure, the carbon could be got off very quickly; and it did not pull the retort down at all. Mr. Warren, of Footscray, said he had steam at 100 lbs. pressure, and found its use satisfactory. Sometimes, however, they could not spare the steam. He had used Mr. Tipper's plan, and preferred it. Mr. Aird, of Townsville, had tried all systems of removing carbon. The most successful had been with a jet of steam. He had put in a 4-inch pipe within a foot of the back of the retort, built it up with brickwork round the mouthpiece, and put on a small jet of steam—enough to cause sufficient draught. The steam was superheated by passing through the hot pipes; and it removed the carbon in from 1½ to 2 hours. In reply to the President, Mr. Aird said at the back of the retort the carbon might be 4 inches thick, and at the side much thicker. Mr. Howlett, of South Melbourne, had used a Meldrum steam-jet. It was a 1½-inch pipe, 12 feet long, with perforated holes; and after the steam had been passed in about one hour, they undoubtedly found that the carbon left the retort much easier than hitherto. Of course, in country works, they had not always got the steam at hand; but the Meldrum steam-jet appeared to act very well. Mr. Bean, of Wangaratta, said he had not used steam in Australia; but he did so in the Old Country, and thought it was a splendid thing for the purpose. He got his idea of using the clay pipe from Mr. Tipper; and found it far better—it burnt the carbon away more quickly than the steam. The only thing one had to watch was that in the first half-hour the mouthpiece of the retort did not get so heated that it fused. After this there was no danger. Mr. Krummell, of Warragul, found Mr. Tipper's plan very effective. He, however, did not put so large a pipe in the retort as had been mentioned, but only a 2-inch one. He thought it took somewhat longer than if he had put in a 4-inch pipe. Mr. T. Lord, of Geelong, said his retorts were something like those at Williamstown. He had a big lid on them with a small frame; and when they wanted to remove the carbon, they simply took off the big lid, and immediately

knocked a hole through the carbon and got a current of air through. He let it stand like this for an hour or an hour-and-a-half, and then they had no trouble in knocking it away. He thought that the systems described by Mr. Tipper and also by Mr. Aird were good.

"What is the best apparatus for automatically lighting and extinguishing street-lamps?"

Mr. T. Lord, of Geelong, said that for anyone to give a fair reply to this question, he must have had a practical experience of the various kinds of automatic lighting and extinguishing apparatus on the market at the present time. Automatic apparatus for controlling the lighting of street lamps might be divided into two classes—namely, the collective and the unit systems. The first system was one under which the lighters were controlled by an increase or decrease of pressure from the gas-works; and he thought the best coming under this heading was probably Dr. Rostin's lighter, which was being tried largely by the Tottenham and Edmonton Gas Company, and by many other large undertakings. He had, however, no experience with the system; but for some years had experimented with clockwork controllers. In Geelong, they had a number of street-lamps fitted with "Zurich" automatic controllers, which he thought were about the most successful introduced. This controller came to Australia with a good reputation; and his experience with it in the street-lamps had confirmed the recommendation. He had had them in constant use since August, 1902, and they had done their work admirably and given little trouble. They were not expensive to maintain, as during the five years they had been in use they had cost under 5s. each; being less than 1s. per clock per year. They were just as reliable for a cluster as for a single light. The only great trouble was the capital outlay. Those he had installed at Geelong cost £4 7s. 6d. each fixed; but these prices included the frog and also the burner. In 1903, he had fixed a number of Gunning controllers, both for single and cluster lights, and was sorry to say they had not proved altogether a success. They were somewhat erratic in their working; and one of their disadvantages was that they could be easily tampered with. But they were very much cheaper than the "Zurich;" and he understood that since he had purchased the Gunning controller in 1903 improvements had been made with it. He had also tried the "Veritas" controller, which worked very well, but was not equal to the "Zurich;" and its price (about £7) put it out of the question altogether. After four years' trial of clockwork controllers, his experience was the "Zurich" was most reliable; and his Company had decided to purchase another 100 of them. With regard to the saving with the clockwork apparatus installed, this worked out at about £60 per year. By the ordinary system, it took an hour to do the lighting; while with the automatic system it was done in five minutes—and, of course, the same was the case with the extinguishing. The only trouble he had had up to the present was with the pilot-lights. So long as they could keep these going, they could depend on the clockwork. That was his experience after a five years' trial. Where the lamps had not lighted, it was generally through the pilot having gone out owing to the wind; and he was afraid that so long as they had to depend on pilot-lights, this would occur. Mr. P. C. Holmes Hunt, of Melbourne, said Mr. Lord had confined himself entirely to the individual system, in which each lamp was separately controlled by a special apparatus. He (Mr. Hunt) felt that the most satisfactory system of controlling the lighting and extinguishing of public lamps must ultimately be found in an apparatus entirely controlled by the pressure from the works. He had referred at their meeting last year to an apparatus worked on this system with which they had been experimenting in Melbourne; and another year's experience with it (in addition to a number of clockwork appliances fixed in various districts) had confirmed his opinion already expressed—namely, that the pressure system promised to be the most satisfactory. They had a number of Gunning's controllers fixed; but the apparatus appeared to be only satisfactory up to a certain point. It did not altogether fit in with the conditions existing in that part of the world, where so much attention was paid to moon-light nights. Pressure control therefore promised best. The apparatus which they had been trying during the past year was one that was invented by an Australian; and it had been very considerably developed during the time it had been in their hands. It certainly had the objection that the gas before use came into contact with the whole of the mechanism; but it was working with a great deal of success, and time alone could show whether the point mentioned was a detriment. The apparatus was known as the "Bruce-Robson." The working portion consisted of a bell working in a mercury seal; the bell being raised when the pressure was raised, and *vice versâ*. In the centre of the cup containing the mercury seal was a standard, to which was attached horizontally a beam which was free to move in see-saw fashion. To either end of the beam were fixed two small bells, also working in two independent mercury seals. One of the bells controlled the gas to the burner, the other to the pilot-light. The gas entered the bell from the centre standard, and found its way to the burner, or the pilot as the case might be, through whichever way was open, due to the small bell being up. The beam on the standard was fitted with a spear point, which was actuated by means of a link-attachment connected to the motor-bell. On the motor-bell rising with the pressure, one end of the beam was pulled up, the opposite end lowering, so that when in use one bell was always up, and the other always sealed. They had fifty of these lighters in use; and although a great deal of experimental work had to be done in connection with them, they were now working with considerable satisfaction. The mercury was undoubtedly a nuisance; but he was glad to say that a modification had been introduced which did away with the mercury entirely, and instead of the bell working in a mercury seal, a leather diaphragm was now employed, and two small leather valves in place of the small cups. One of these had been fixed alongside the original ones for some months, and had worked without any difficulty worth mentioning. He was contemplating recommending his Board to put in a more extensive installation. As to price, they cost about £2 each fixed. The pressure required for operating was 5-10ths above the maximum, both for lighting and extinguishing. Of course, they had a great deal to learn with regard to the leather, as to whether the diaphragm would last any length of time without deteriorating or leaking, which was a matter that experience alone could prove. However, the diaphragms did not cost very much. Whichever form was used, it had to be weighted and adjusted to suit local requirements. Once adjusted, the apparatus would continue to work so long as the pressure arrangements were maintained. Mr. Marsh, of Mentone, said he had had some experience in automatic lighting, having had an apparatus fixed for two years on all the lamps in his district. The lighters were an arrangement of his own, being fitted with ordinary Ansonia clocks; and they worked very well. The maintenance for the two years had not cost them anything at all.

IMPORTANT GAS ENGINEERING CONTRACTS.

It has already been announced in the "JOURNAL" that Messrs. Ashmore, Benson, Pease, and Co., Limited, of Stockton-on-Tees, have obtained the contract for the four-lift holder for the Manchester Corporation. The following particulars in regard to the work may be of interest. The outer lift is 282 feet in diameter, and each of the four lifts is 42 ft. 6 in. deep. The guide-framing consists of 32 steel lattice standards 168 feet high, connected by six tiers of steel lattice girders, and tied together with diagonally crossed bracing-bars. The crown of the holder has a rise of 20 feet in the centre. When out of action, the crown is supported on a steel framing, consisting of 180 upright stanchions braced together circumferentially, radially, and diagonally. They are secured in the tank by 720 rag-bolts let into concrete. The main inlet and outlet pipes are of steel, 3 ft. 6 in. diameter. In the tank and in each of the cups of the second, third, and fourth lifts, apparatus will be fixed for applying steam to prevent the water freezing in cold weather. The total weight of steelwork in the contract is nearly 3500 tons. The holder will be the third largest in the world, and will contain 10 million cubic feet of gas. The next largest is that of the South Metropolitan Gas Company, and holds 12½ million cubic feet; while the largest is the New York holder, of which the capacity is 15 millions. In the London case, however, the guide-framing is not carried to the full height of the structure; so that the Manchester holder, while not quite the largest in the world, is probably the heaviest of its kind. It has been designed by Mr. J. Gibson Newbigging, M.Inst.C.E., the Gas Engineer to the Corporation. The tank to contain the holder, also designed by Mr. Newbigging, is being constructed of masonry by a local contractor. Messrs. Ashmore, Benson, Pease, and Co. built the last largest gasholder and guide-framing for the Manchester Corporation at the same works in 1893; and had carried out many other important gas-storage contracts for them in previous years.

It may be mentioned that the firm have been entrusted by the Gas Committee of the Barrow-in-Furness Corporation with the contract to add a third lift to a two-lift gasholder 99 ft. 6 ins. by 20 ft. The existing holder is guided by cast-iron columns for the outer lift, and by Pease's patent steel cable system for the second lift; and this system will also be applied to the lift which is to be added. They have also in hand an order from the West Bromwich Corporation to add an outer lift to a two-lift gasholder 123 ft. by 30 ft.; and the present inner lift (which will then be the third lift) will "fly" clear of the guide-framing. The Chertsey Gas Company have recently placed an order with the firm for a two-lift gasholder and steel tank, to be erected to the design of their Engineer, Mr. H. J. Hamilton. The tank will stand on a concrete base at the ground level. The holder, which will contain about 200,000 cubic feet of gas, will be guided by eight steel standards and two tiers of girders; the standards rising for the full height of the two lifts, and being extended down the sides of the tank to the ground.

Other important contracts in hand comprise a gasholder for the Long Sutton Gas Company; a retort-house roof at the Fulham station of the Gaslight and Coke Company; a steel-frame building for a retort-house with roof, purifiers 30 feet square and 6 feet deep, primary and secondary condensers, and a washer-scrubber for the Yokohama (Japan) Municipal Gas-Works; a retort-house stage floor, &c., for the Tynemouth Gas Company; and several gas plants for the War Office, for Australia, Argentina, &c. Interesting work just completed includes a combined gasholder and oil-store tank designed by Mr. T. H. Duxbury, the Engineer and Manager of the South Shields Gas Company, and a gasholder and tank for Japan.

We learn that the works of the firm, which have been practically rebuilt and fitted with up-to-date appliances, are busily engaged in all departments. They occupy an area upwards of 8 acres in extent, and employ more than 600 men; while a further large number are engaged in various parts of the world on erecting work. Extensive work is done in blast-furnace plants, coke-ovens, and bye-products plant, &c. Many large and important contracts have been carried out by the firm for the Mersey Dock and Harbour Board, the Manchester Dock and Warehouse Company, and the Manchester Ship Canal Company—one in particular being the large double steel syphon-pipe passing under the Canal, which, it may be remembered, was built upon a staging on the Canal side, and afterwards floated down into position.

LAYING A WATER-MAIN UNDER A SIDE-WALK.

In a recent number of "Engineering Record," particulars were given in regard to the laying of a large water-main, comprising 20,526 feet of 20-inch pipe, under side-walks in Utica (N.Y.). The work was done for the Consolidated Water Company of that city—partly by their own men, and partly under contract; the whole work being carried out under the general direction of their Chief Engineer, Mr. A. B. Tracy.

The route of the pipe-line was in the busiest streets of the city; and it was important to lay the main with as little disturbance to traffic as possible. These streets are for the most part paved with comparatively new sheet asphalt, and trenching would not only have greatly obstructed traffic, but would also, on account of the difficulty of carrying out satisfactory repairs, have shortened the life of a considerable part of the pavement. A large proportion of the side-walks along the streets traversed are of the stone flagging variety; and it was thought that these could be economically removed and subsequently replaced in a satisfactory manner. These various considerations led to the adoption of a route for the main under the side-walks wherever possible, and in a few places under lawns between the side-walk and the kerb; thus interfering with neither pavement nor side-walk. While the advantages of the latter route from an economic point of view were evident, there was considerable diversity of opinion among the property owners along the route; and the harmonizing of these differences, though finally accomplished, was no small task. The more prominent direct results arrived at by following out this policy were the minimum of interference with the heavy traffic; the avoidance of a continuous patch along the asphalt pavements which, with the most favourable conditions and the most careful workmanship, must be a serious detriment to the street; the actual improvement of the appearance and quality of the walks by relaying to line and grade and replacing cracked and broken flagging with new stone; and the saving in cost of from $1·50 to $2 per foot run, depending largely on the proportion of flagging stone to be replaced.

Owing to lack of accurate records concerning the position of many existing water-mains, as well as other public service-pipes, it was impossible to determine in advance of the excavation the best method of making, or the exact location of, the cross connections between the new and the old mains. The ordinary method of procedure, therefore, was to excavate the trench and lay the new pipe straight through, crossing intersecting streets without regard to the location of the connection, and afterwards make the connections by means of split tapping sleeves. This method allowed the main gang to work uninterruptedly, avoiding the delay arising from determining, by investigation on the ground, the point at which a T-piece would have to be set, and the cutting of the 20-inch pipe after such determination had been made. With this delay disposed of, the gang was able, with other conditions normal, to do 300 feet of completed work per day.

Features outside the regular street construction were the crossing at two different points under the bed of the Erie Canal; the pipe being encased in a concrete jacket at these points. Pipe weighing 2250 lbs. per 12-feet length was used for the entire line. All pipes were laid to an established line and grade; the more abrupt changes in direction, both horizontal and vertical, being made with special bends having a 5-feet radius, while changes in direction made by deflecting a 12-feet length of pipe were based on a maximum deflection of rather more than 2° in a length of pipe from the direction of the pipe next preceding, or laying to a curve with a radius of 233·59 feet. Connections were made with all existing mains at intersecting streets.

The pipe-laying gang was followed by a connecting gang, who did such additional excavation work as was necessary to determine the best method of making each connection, and also made the connections. A split sleeve was attached to the new main with the proper size of projecting branch, and a similar sleeve with the same size branch was attached to the crossing line. The two sleeves were then tapped out, and the branches connected up with suitable lengths of pipe and bends. For cutting the pipe inside the sleeves, a tapping-machine was used, with which the work was done without shutting off the flow of water in the main or reducing the pressure. The split sleeve for the 20-inch pipe was a modification of those generally employed; being designed for this work, and having a bell and hub branch into which the connecting-pipe could be leaded directly without the intervention of the usual valve. By this arrangement, the 20-inch sleeve could be set with its branch at any point on the circumference of the outer shell of the pipe, and with the new main passing under or over existing mains. The branch between this sleeve and the regular sleeve and valve attached to the existing main consisted of two short pieces of pipe and a bend, ordinarily a 90°; otherwise one of the smaller standard bends, or a combination thereof. This allowed of the shortest possible branch between the mains. The tap in the new main was, of course, made dry. More than thirty connections were made in this same manner, mostly with 6 and 8 inch mains. The few made with existing 4-inch mains were ordinarily tapped out 8 inches on the new main, and reduced temporarily so as to provide for future mains of a larger size without retapping.

The additional labour involved in making the cuts and the extra lead and oakum needed for the 20-inch sleeve beyond what would be required for a regular T-piece, would appear, on first thought, to increase the cost over the ordinary method of making connections; but the economy effected in 20-inch pipe by avoiding cutting at each of these points, and the saving in time by being able to lay the 20-inch line continuously, also in making shut-offs and giving notice of impending shut-offs in many cases to quite extended districts, to say nothing of the advantages of maintaining an uninterrupted service to hydrants and consumers, more than compensated for these items of increased cost.

Between 50 and 60 new hydrants with 6 and 8 inch branches leading direct from the large main were installed and are in operation. Each hydrant is supplied with an independent valve, so that it can be shut off from the main and necessary repairs made, or the hydrant entirely removed and another substituted, without throwing other hydrants out of use or shutting off the main line. On portions of the side-walk route, the distance from the main to the kerb line was not more than 6 or 8 feet, necessitating very short hydrant branches; the distance between the base of the hydrant and the branch of a regular T-piece being altogether too short to allow of an attempt to instal a regular 6 or 8 inch double hub valve without danger of its being blown off in case the hydrant was removed. At such points, split tapping-sleeves were again employed, dispensing with regular T-pieces, and allowing the valve to be attached directly to the 20-inch main, whence a short branch leads direct to the hydrant. This arrangement precludes the possibility of a blow-off in case a hydrant is removed, and at the same time makes a very close connection between the hydrant and the main. Pressures of from 90 to 108 lbs. per square inch are available at the nozzles of the 6-feet hydrants installed on this line, according to their relative elevations.

FILTRATION AND PURIFICATION OF WATER.

At the Meeting of the Junior Institution of Engineers on the 7th inst., a paper on the "Filtration and Purification of Water" was read by Mr. G. H. Hughes. The communication was accompanied by tables and diagrams.

At the outset, the author emphasized the importance of water used for a public supply being clear and bright, without colour, taste, or smell, agreeable for drinking, and free from pathogenic bacteria or injurious chemicals, whether in suspension or solution. Absolutely pure water, however, could not, he said, be obtained from Nature; and consequently from very ancient times man had striven to remove foreign substances from it. The Japanese and the Egyptians were credited with having used, at a very early period, vessels of sandstone or unglazed earthenware for filtering water. The system of allowing water to percolate by gravity through a porous body had been found very efficient in removing matter in suspension. Fine sand had taken the place of porous sandstone, and was now considered the best filtering medium. To remove the grosser solids in suspension, it was advisable to allow the water to rest in tanks or reservoirs before it was passed on to the filters. This was the sedimentation process, which, in addition to facilitating the deposit of a quantity of suspended matter, improved the water in several respects. From the sedimentation tanks the water was conducted to the filters, which were of two kinds—gravitation and mechanical—the latter type being employed with and without the use of chemicals.

Proceeding to deal with the two classes of filters named, the author said the first, in which the water passes through by gravity, was the best. He advocated the closing-in of all filters by brick or ferro-concrete arches, and putting on them an earth covering at least 18 inches thick, turfed over. This kept the water at a fairly uniform temperature, excluded dust, and mitigated the effects of frost. The average total depth of a sand filter might be taken as 9 feet. The filtering materials were usually about 6 feet thick, consisting of 3 feet of sharp, fine sand on the top and 1 foot each of pea gravel, coarse gravel, and stones. The drains might be arranged herring-bone fashion, and should be 3-inch or 4-inch agricultural drains running into larger ones about 9 or 12 inches in diameter, which should have a drain about 18 to 24 inches, so as to give a regular downward flow of water through the mass and uniform support to the sand; the under-drains being designed to carry the water to the outlet well. Mr. Hughes explained that when a filter-bed of this kind is first put into operation, very little improvement is effected in the water. The finer

particles of foreign matter are arrested in the sand, and after a time the grains become coated with a sticky slime, which is really the efficient factor of the filter—it being composed of nitrifying organisms which cause the decomposition of the organic matter in the water. After some time, the slime is removed, and the sand to the depth of about half-an-inch is scraped off and washed for use again. The intervals between the cleaning operations vary according to the quality of the water; the average for the Metropolitan Water Board last year being 40 days. The rate of filtration should not exceed from 450 to 500 gallons per superficial yard per day; but in determining the size of a filter, allowance must be made, according to the special circumstances, for an increased area, 4 inches in depth, of water passing through in 24 hours, which is equal to 3000 square yards of superficial filter area for each million gallons required per diem. Uncovered filters cost in England about £10,000 per acre; covered ones, £15,000. In London, the cost of working is stated to be from 3s. 0½d. to 4s. 9d. per million gallons—an average of 3s. 10½d. The author calculated that the sand filters of the Metropolitan Water Board removed on an average last year 92·5 per cent. of the bacteria in the raw Thames water which passed through them. Other filtering media referred to were silicated carbon, polarite, and coke; but, in his opinion, sand was the best, taking all things into account.

Passing on to consider mechanical filters—*i.e.*, those in which the sand is washed without removal—Mr. Hughes described first those working without chemicals. He said they were practically combined filters and sand-washers, and were excellent to remove a large percentage of the impurities in suspension. They were suitable for manufacturing purposes, and good for domestic use where the water was free from bacteria. They might also be applied advantageously as roughing filters, to remove all matter in suspension before the water was passed on to the filter for the removal of bacteria. Each 3 feet of area would filter 9000 gallons of water per 24 hours, or 27,000 gallons per square yard of area, compared with from 450 to 500 gallons by gravitation sand filters. With regard to mechanical filters using chemicals, the author said alum had been employed for centuries to precipitate matter in water; and the results showed that filters in which it was used had in certain cases a bacteriological efficiency of 99·87 per cent. He expressed the opinion that in the future mechanical filters would surpass the old type of open filter-beds, not only in respect of initial cost and economy of cleansing, but on account of their greater bacterial efficiency when scientifically controlled and properly looked after. This, he said, could only be done by the chemical and bacterial examination of the water at frequent intervals; and the same remark applied to sand filters. Having given a list of the different mechanical filters on the market, he made a few explanatory remarks upon each.

The concluding portion of the paper was devoted to the subject of softening and sterilizing water; the most usual methods employed in the operation being the lime and soda processes separately and in combination. The author stated that the lime process was invented by Dr. Clark, of Aberdeen, some fifty years ago, for softening waters containing bicarbonates of lime and magnesia; and he explained that in the soda process carbonate or hydrate of soda added to water containing sulphates of lime and magnesia react upon the sulphates and form carbonates which are precipitated, while the neutral sulphate remains in solution. A water-softening plant consists of a tank or vessel to hold the lime or soda, which should preferably be in solution, so that a measured quantity of known strength can be added to a measured quantity of the water to be treated. The solution should be made to mix with the raw water as both flow into a settling-tank. After resting in the tank, the reaction is completed, the insoluble carbonates and sulphates are precipitated, and finally rest on the bottom, and the clear water may be drawn off. The time will vary according to the depth of the tank—one 10 feet deep will take about 24 hours to clear the water. With regard to sterilization, the author gave an account of an experiment he carried out with copper sulphate in connection with a South African water which occasionally suffered by the rapid development of algæ. This was corrected by the application of 3 parts per million. The sulphate was put into canvas bags and towed over the surface of the settling-tanks and reservoir, the filters were cleaned out, and afterwards everything was washed. Chemical and bacteriological tests were made, and no trace of copper was found in the water supplied to the consumers. Mr. Hughes said he did not advocate the repeated use of copper sulphate, but considered its immediate application justifiable in cases of emergency, if every precaution was taken to prevent any copper being conveyed to the consumer. A safer germicide, in his opinion, is an electrolitic hypochlorite. Chloride of sodium is split up into its constituents by an electric current, and combines with the oxygen and the hydrogen in the water, forming an unstable hypochlorite, which is fatal to all forms of bacteria and algæ. In less than 24 hours the hypochlorite recombines with the sodium, forming common salt, which is harmless to man in the small percentage left in the water. Ozone plants have been applied at West Philadelphia, in Holland, and elsewhere, except in England, as far as the author is aware, for the purification of water; but he considers the process expensive compared with others. Aëration is good in the case of water containing iron—85 per cent. having been removed in this way; and it is also most useful in re-vitalizing water which has been rendered flat and unpalatable by boiling.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress had been made with Bills when the House rose last Tuesday for the Easter recess:—

Bill brought from the Commons, read the first time, and referred to the Examiners: Dartford Gas Bill.

Bills reported, with amendments: Bognor Gaslight and Coke Company Bill, Derby Gas Bill, Swansea Valley Gas Bill.

HOUSE OF COMMONS.

Notwithstanding the adjournment of the House from the 6th to the 14th inst., in consequence of the resignation of the Prime Minister (Sir Henry Campbell-Bannerman) on account of continued ill-health, and the attendant reconstruction of the Cabinet on Mr. Asquith, the Chancellor of the Exchequer, succeeding to the position, the Committees continued sitting. Down to last Tuesday, however, when the House rose for the Easter recess, the only further progress made with Private Bills in which our readers are concerned was the following:—

Bills reported with amendments: Manchester Corporation Bill, Margate Corporation Bill.

Bill read the third time and passed: Dartford Gas Bill.

Petitions have been presented against the following Bills, brought from the Lords:—

Llanelly Gas Bill, by the Llanelly Urban District Council.

Pontypridd Water Bill, by the Glamorgan County Council; the Caerphilly, Mountain Ash, Pontypridd, and Rhondda Urban District Councils; the Neath and the Llantrisant and Llantwit Fardre Rural District Councils; and owners and occupiers of houses and property, &c., within the limits of supply.

Skegness Urban District Council Bill, by the Skegness Water Company.

On the motion of Mr. Henry Forster, a return has been ordered showing the following particulars with respect to Town Councils, other Urban District Councils, and Metropolitan Borough Councils in England and Wales: Area of district of each council; population of district according to the last census; rateable or assessable value of district; rates in the pound of the principal rates raised in the year 1905-6 by, or for the purposes of, each council; the outstanding balance, at the end of the year 1905-6, of loans contracted by, or repayable by, each council, distinguishing between (1) loans for water-works, gas-works, electric lighting, tramways, markets, or harbours, docks, &c., and (2) loans for other purposes; and amounts remaining in the sinking funds, loans funds, and redemption funds of each council at the end of the year 1905-6. This return is in substitution for one on similar lines made at the close of last session.

Municipal Finances at Warrington.

In the course of his budget speech to the Warrington Town Council, Alderman Bennett, Chairman of the Finance Committee, said an extra improvement rate of over 7d. in the pound would have been necessary, but happily the Gas Committee had once more come to their rescue, by consenting to provide £1500 over and above the £10,000 which they originally promised; and this fact, coupled with the extra productiveness of the improvement rate, would enable them to meet their obligations by an increase of 6d. in the pound. He said that personally he was very sanguine as to the future of the great reproductive undertakings. The gas-works had done splendidly, thanks largely to Mr. Haddock, the Engineer, and his staff, and would probably, ere long, do better still. They might indeed have expected a further benefaction from this veritable "Purse of Fortunatus" in the present year, had it not been for the increased cost of coal, which was estimated to absorb the sum of £5500. And, while coal was rising in price, the price of gas had been lowered by 2d. per 1000 cubic feet, which meant a solid gain to the consumer, but a loss to the department last year of not less than £2254. The two together would make a difference in the available profit of £7754. The Electricity Department made a gross profit last year of £7709; and, after providing for sinking fund and interest, there was a net profit of not less than £2517. This was carried to the reserve fund, which already stood at £6952. As soon as it reached one-tenth of the capital expenditure—a time which was rapidly approaching—the concern would, he hoped, be able to make substantial contributions in relief of the rates. In spite of the enormous cost of the extensions, the water-works were getting within a measureable distance of making both ends meet, and would, no doubt, eventually produce a profit, which could be applied to the relief of the rates.

Gas Profits at Macclesfield.—The net profit of the Macclesfield Corporation gas undertaking for the past year amounts to £8176, as against £7463 in 1907, £7229 in 1906, and £5543 in 1905. Of the past year's profits, £1000 will be added to the maintenance fund; and the balance will go to the relief of the rates.

Charge against an Office Boy at Batley.—A boy sixteen years of age, named Charles Ainsworth, has been arrested at Batley, on a charge of embezzling money belonging to the Corporation. He had been office boy at the gas-works, and had accused three of his companions of having stolen a pair of boots belonging to him. The lads stated that it was only a joke; and Ainsworth then appeared to have got uneasy lest his parents should find out that he had purchased the boots and a bicycle without their knowledge. A private meeting of the Gas Committee was subsequently held; and it was discovered that certain money was missing.

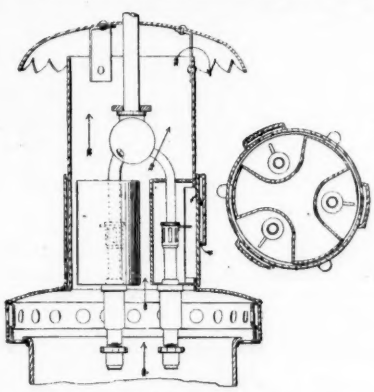
REGISTER OF PATENTS.

Inverted Incandescent Gas-Lamps.

WIGLEY, P., ARCULUS, G. N. & E. A., and WARRY, J. (Alfred Arculus and Co.), of Birmingham.

No. 2563; Feb. 1, 1907.

This invention has reference particularly to incandescent gas-lamps in which two or more inverted burners are arranged within one glass or globe; the heated products of combustion passing away through an up-take tube or passage formed in the top part of the lamp. The invention consists in arranging the parts so that the air supply to the air-bulb of the bunsen burner is effectually prevented from being contaminated by the products of combustion rising from the burners.



Arculus and Co.'s Inverted Gas-Lamps.

As shown, each of the air-inlet bulbs belonging to the burners is contained in a separate compartment or part of the top of the lamp so arranged as to receive from the outside air not contaminated by the products of combustion rising from the burners, which pass up an up-take in the central portion of the upper part of the lamp. The compartments for containing the air-bulbs may be arranged in various ways, so as to render them readily accessible from the outside for cleaning or for regulating the air supply or gas-jet. Each compartment may, for instance, be made in the form of a side cavity of the up-take, so as to contain the air-bulb, and enclosed by a grating through which fresh air passes to the air-bulb, and preferably made with deflector plates or baffles, so as to prevent the supply of air to the bulbs being influenced by the outside draughts. The grating or gratings can be so hinged or made to slide as to give access to the cavities and air-bulbs. Or, if desired, the bulbs may be arranged on the outside of the up-take, which would then be of a plain cylindrical form; the down pipes leading from the bulbs to the burner-tips being bent or inclined if necessary. In this case, the air-bulbs to which the gas supply is connected are enclosed by separate removable outer casings, so arranged as to protect the bulbs from draughts and rain.

Manufacture of Incandescent Mantles.

BUHLMANN, G., of Berlin.

No. 6828; March 21, 1907. Date claimed under International Convention, June 28, 1906.

As is well known, the patentee remarks, the incandescent light trade has, in addition to finished and burnt-off incandescent mantles, to deal with large quantities of impregnated but not burnt-off materials. It is essential that such mantles should be non-hygroscopic—inasmuch as mantles with but a trace of moisture burn off very badly. In view of this it has been the practice to pack mantles intended for sea-transport in zinc boxes well-soldered all round; but this preparation has proved to be no safeguard against the difficulties mentioned—especially in countries with damp climates. He claims to have found that all the troubles experienced (which are particularly noticeable where artificial silk is used) can be avoided by reducing the acidity of the fluids used for impregnation of the mantles; and in order to accomplish this, several ways and means can be employed.

The addition of ammonia to the usual solution consisting of nitrates of thorium or cerium will accomplish the purpose best; but, instead of ammonia, other volatile bases may be employed. Furthermore, hydroxide of thorium ($Th(OH)_4$), hydroxide of cerium ($Ce_2(OH)_6$), hydroxide of beryllium ($Be(OH)_2$), or hydroxide of aluminium ($Al(OH)_3$) may be used to advantage, or they can be used in the form of their organic non-precipitating salts.

Any one of these chemicals is capable of reducing the acidity of the commonly used solution of nitrates of thorium or cerium, if added in proper proportion. The limit point up to which the additions may be safely carried, is the so-called point of saturation. This limit is reached at the moment when precipitations settle at the bottom of the solution which do not dissolve even if the solution be well shaken. Thus as long as the precipitations caused by the added chemicals in the fluid dissolve again, so that the solution remains clear or becomes clear again after being well shaken, the point of saturation has not been reached; but as soon as the precipitation leaves some sediment in the fluid which does not dissolve again, the solution has absorbed all the addition of which it is capable—in other words, the fluid is saturated and no more chemicals must be added.

In case ammonia is selected as the acidity reducer, it is to be carefully added to the solution and hydrates of the rare earth salts are precipitated therein, which readily redissolve if the whole solution is well shaken. When, therefore, a sediment of these precipitations remains undissolved in the solution after being shaken, the saturation point of the solution in regard to the taking of additional ammonia is reached. Should, however, a slight precipitation remain, it can easily be removed by filtering the solution.

If thorium-oxide, or the ashes of incandescent mantles are chosen as the reducers of the acidity of the solution, they can be added in excess. The surplus remaining non-dissolved in the fluid is removed by filtration. Another method of adding such oxides would be to place them in layers upon a filter and then pour the solution over them—thus making the solution slowly run through the layer.

Treating the Effluents from Ammonia Stills.

GROSSMANN, J., of Manchester.

No. 7932; April 5, 1907.*

Attempts at using the effluents from ammonia stills for raising steam in boilers and for other local purposes have so far, the patentee states, been unsuccessful. He claims, however, to have found that those compounds which in a steam boiler settle out and are the main cause of incrustation taking place can be removed by treating the effluent with barium carbonate. He has also found by experiment that if the effluent, after being freed from suspended matter by settling or filtration, is agitated with a sufficient quantity of barium carbonate for a sufficient length of time, and then left standing for a sufficient length of time, the resulting clear liquor can be evaporated to a small bulk without forming incrustation or depositing insoluble lime salts. Further, he has found that the reaction is accelerated and made more efficient if the effluent, which coming from the stills, and even after the suspended matter has been removed by settling or filtration, is alkaline, is before treatment with barium carbonate neutralized or slightly acidified; and that for the purpose of neutralizing or acidifying carbonic acid or waste-flue gases produced in the combustion of coal or similar fuel may be used.

In order to carry out his present invention, he proceeds as follows: He determines, in the first place in the laboratory, what is the total quantity of sulphate in an average sample of the clear settled effluent, and then neutralizes or slightly acidifies a measured quantity of the clear settled effluent, and agitates it for several hours with a quantity of barium carbonate equivalent to the sulphate found by the test to be contained in it. The liquor is left standing for twelve hours, and he determines in the clear filtrate the amount of sulphate left in solution. Assuming, for instance, that only 75 per cent. of the total sulphate was found to have been removed, it would show that the efficiency obtainable would only be 75 per cent., and that he should require at least an excess of 33⅓ per cent. of barium carbonate to produce complete reaction. Such a liquor might on a large scale be treated as follows.

A measured quantity of the clear settled effluent—for instance, 1000 gallons—is placed in a tank provided with an agitating arrangement, and carbonic acid or flue gases passed through it, or hydrochloric or other suitable acid added to it, until the liquor is neutral or slightly acid. Such a quantity of barium carbonate is now added to it as would be equivalent to one-and-a-third times the quantity required by theory. The liquor is now agitated until the reaction is completed, and is run into settling tanks and left to settle for about twelve hours. The clear liquor is separated from the precipitate by decantation or filtration, or by a combination of both.

Instead of thus using a quantity of barium carbonate only slightly in excess of that required by theory, a large excess may be used and so much of it replaced after each operation as has become decomposed. In the instance given, the 1000 gallons, after preliminary treatment as before, might be mixed with two, five, or ten times or any other multiple of the quantity of barium carbonate which would correspond to the equivalent of the total sulphate present.

After agitating, settling, and removing of the liquid, a quantity of barium carbonate equal to the equivalent of the total sulphate present in 1000 gallons would be added to the sediment, and the latter again agitated with a further 1000 gallons of the effluent, and so on. The greater the number of operations which are performed successively in this manner, and the smaller the excess of barium carbonate used in the first operation, the less will be the percentage of barium carbonate which will be in the sediment when, on account of its bulk becoming too large, it is finally withdrawn from the cycle. The sediment will then consist chiefly of calcium carbonate and barium sulphate; and these two may be separated by levigation. It may before or after levigation be treated with soda or sulphuric acid, or sodium sulphate, or nitre cake, used successively or simultaneously, in order to produce marketable products and recover products of commercial value; or the components of the residue may, by suitable treatment, be reconverted into barium carbonate.

Before treatment with barium carbonate, free ammonia may be eliminated from the effluent by a current of air or steam. Apart from the use of carbonic acid or flue gases for the purpose of removing the alkalinity of the effluent, a current of these gases (by themselves or mixed with air or steam, separately or together) may be used during the operation in the mixing tank. The reaction with barium carbonate takes place better with neutral or slightly acid clear settled effluent, but may also be performed without previously settling, neutralizing, or acidifying the effluent.

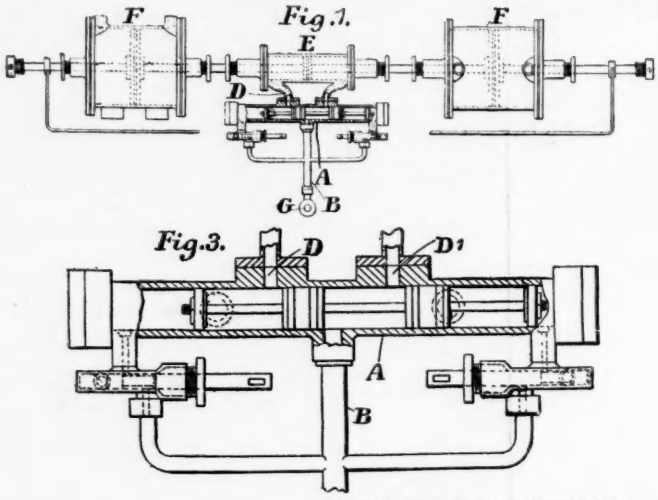
High-Pressure Gas-Lighting Plant.

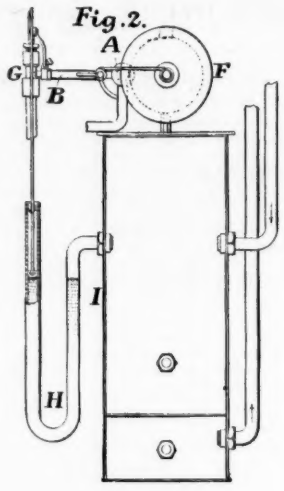
BROWN, T. W., of Finsbury Park, N.

No. 5972; March 12, 1907.

This invention relates to apparatus for operating pumps, motors, and other engines by hydraulic or water power in connection with high-pressure gas-lighting. The supply of motive fluid is intended to be obtained from the usual domestic water supply pipe, and is operable by the pressure under which the water is ordinarily supplied.

* This is the patent referred to in the concluding paragraph of Dr. Grossmann's letter in the "JOURNAL" for April 7.





Brown's High-Pressure Gas-Lighting Plant.

Fig. 1 illustrates apparatus adapted for working according to this invention. Fig. 2 is an end view showing the compressed-gas chamber and the means of regulating the supply of motive fluid. Fig. 3 is an enlarged view of the distributing valve for the motive fluid.

A is the cylinder or barrel to which the motive fluid is admitted by way of the supply pipe B. In this cylinder is a valve adapted to open and close ports D D^1, which lead to the piston chamber E of the pump-motor; the rod of the piston being connected with the piston or pistons of the compressor or compressors F. G is a valve whereby the motive fluid is admitted to the chamber A; being adapted for regulation by a connecting rod or plunger operated by the safety valve H pertaining to the receptacle I for the compressed gas. This container is divided into two compartments, the lower one of which is adapted to receive the gas at the ordinary pressure, and whence it passes to the gas-compressors F—a check-valve being provided on the compressors at the points of entry. The gas, after compression, passes into the upper compartment of the receptacle I, from which it may be conducted to the burners for consumption.

The safety valve H consists of a bent pipe containing water, glycerine, mercury, oil, or other fluid, whereby a seal is provided for the compressed gas contained in the receptacle. As the pressure of the gas varies, the action of the pressure of the gas on the water in the pipe H will also vary, and so actuate a rod or plunger by means of the piston with which it is provided. When the level in the outer member of the pipe H rises or falls, the connecting rod is influenced and actuates the lever, thereby opening or closing more or less the valve G, which supplies the motive fluid to the chamber A. By these means the compression is regulated automatically; and if the pressure becomes excessive, the supply of motive fluid will be reduced or cut off until the pressure in the upper compartment of I is lessened.

The ends of the cylinder A are in communication with the feed-pipe B by means of bye-pass pipes provided with valves or cocks, each having a sliding piston. The piston valves are connected with rods so as to be operated each time the piston-rod pertaining to the pistons of the compressors F is operated. The bye-pass pipes are thus rendered open to the feed or to the exhaust, as the case may be, according to the working of the apparatus.

The water passes through the pipe B to the valves, which are automatically controlled and actuated by rods; so that the motive fluid passes to the cylinder A at each end alternately—at the same time opening one of the exhaust ports. The main feed passes along the pipe B to the chamber A between the pistons in the chamber, which pistons (connected by a rod) are controlled by the admission or non-admission of water by the operation of the valves, whereby the feed is allowed to pass alternately into and through the connections D D^1 to the chamber E to operate the piston therein. The exhaust is discharged, by way of the connection D or D^1 (for the time being not open to the admission of motive fluid), back to the chamber A between one of the centre pistons and the outer pistons to the exhaust pipe.

By means of rods the cocks or valves pertaining to the bye-pass pipes are alternately actuated. So that the one is open to the feed and closed to the exhaust; while the other is open to the exhaust and closed to the feed, and *vice versa* alternately. Thus the motive fluid is caused to act first upon the piston at one end of the cylinder or barrel, and so cause the valve in the latter to move in one direction, and then upon the piston at the other end, so as to cause the valve to move in the opposite direction—the valve successively uncovering and covering the ports leading to the cylinder E, actuating the piston therein and exhausting the motive fluid therefrom. The exhaust passes from the cylinder into the space in the cylinder or barrel pertaining to the admission valve situated between the latter and the pistons at each end of the cylinder or barrel.

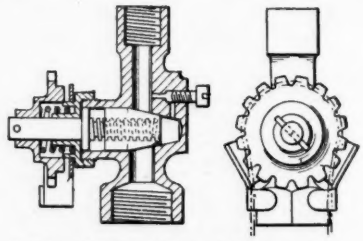
Gas Valves and Cocks.

MILLS, F. B., and TEMPLE, W. G., of Kentish Town Road, N.W.

No. 8572; April 12, 1907.

This invention provides means for reducing by a definite amount the flow of gas in a pipe or main, and (where so required) diverting the reduced supply to another channel; also means for controlling the reduced supply independently of the main valve.

The main valve proper (as shown) has a conical seat arranged in the main casting transversely to the direction of flow, and is carried on a threaded part of the operating spindle. A chain wheel, rigidly attached to the outer end of the operating spindle, is adapted, when rotated by a chain, to cause the valve proper to advance towards, or recede without rotation from, its seating in the main casting. For the auxiliary or reduced supply, the boring of the conical seating is extended so as to form a recess or chamber behind the valve proper; and a slot or notch in the main valve allows gas to enter the recess, whence it is led



Mills and Temple's Regulating Gas-Cock.

away as desired. An adjusting screw is provided to regulate the passage way of the bye pass. On closing or reducing the main gas-way, the chain wheel is rotated, taking with it the weighted lever for (say) half-a-turn, when the chain will be arrested in its movement by a stop provided for the purpose, and the main lever will disengage itself and continue to fall by gravity; it being retarded by friction by the dash-pot action of a small spring-controlled piston arranged behind the main valve to resist its forward and inward movement.

Equalizing the Flow and Pressure in Pumps, Blowers, and the Like.

THORP, T., of Whitefield, near Manchester.

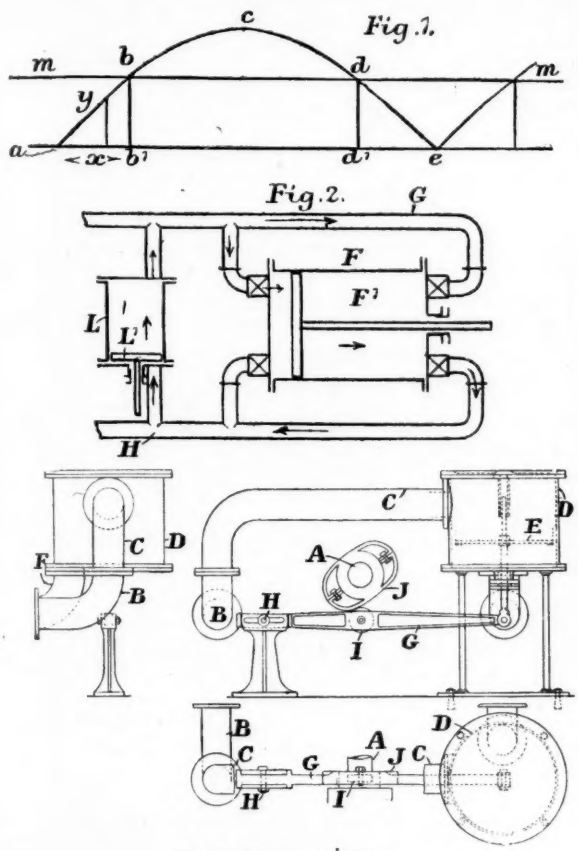
No. 9186; April 20, 1907.

In rotary blowers, pumps, and similar machines, the patentee points out, the quantity of fluid drawn into, and delivered by, them varies continually during each stroke or revolution, causing corresponding variations in the flow and pressure in the suction and delivery pipes, "which pulsations frequently injuriously affect the meters employed for measuring the quantities delivered by the machines, or the working of the latter." The object of the invention is to remedy this defect, by connecting to the suction pipe or to the delivery pipe, or to each of them, according to the requirements of the case, "an expansible and contractible chamber, the capacity of which equals the excess above, and the deficiency below, the mean volume drawn in or discharged by the machines during each stroke, and expand and contract this chamber at the same rate as the volume sucked in or discharged increases above, or decreases below, the mean volume."

In fig. 1 (p. 171) application of the method to a double-acting pump is represented. The diagram of the piston speeds and variation of volume drawn in and delivered is a sine curve *a b c d e;* the abscissae *x* representing the flattened arc of the crank circle from its dead-centre, and the ordinates *y* the corresponding piston speeds and rates of flow into, or out of, the cylinder. These increase from zero at the beginning of the piston stroke to a maximum at the middle, and then decrease again to zero at the end—the mean speed and volume being represented by a line *m m*. The volume of fluid drawn in or delivered by the pump varies in the same ratio as the speed; and if no provision is made for the equalization of the flow of the fluid in the pipe, the flow and pressure would vary correspondingly.

In order to obviate this, the arrangement represented by fig. 2 is employed. The pump cylinder F is connected to the supply or suction pipe G at each end through valve-boxes and to the delivery pipe H through other valve-boxes. The suction pipe is connected by another branch to one end of the cylinder L, and the delivery pipe to its other end. Now if the piston L^1 of this cylinder is reciprocated by a cam on the crank-shaft, and by link and lever connection or equivalent means, so as to make two strokes for each stroke of the pump piston F^1, at a variable speed changing as the ordinates drawn from the curve *a b c d e* to the mean line *m*, and is of such size that it takes in a volume equal to the excess or deficiency above or below the mean volume drawn in

or discharged by the pump, and is further so timed that it starts from the end of its stroke when the crank driving the pump is at the positions corresponding to the points b^1 and d^1 of the dead-centre, it will draw in the excess volume on the delivery side from the main H, while the piston moves quicker than the mean speed and the crank rotates from b^1 to d^1, and discharge it again into this main during the remainder of the crank rotation. But on the suction side the fluid is forced out of the cylinder L into the suction main G, while the pump piston F^1 moves at excess speed, and is drawn into it while the pump piston moves at a speed below its mean speed. As the speed of the piston L^1 varies exactly as the variations of the speed of the pump piston above or below the mean speed, it is evident that the volumes drawn by the combined action of both pistons from the suction pipe G or delivered into the delivery pipe H will remain equal for equal angular movements of the crank-shaft, and the speed and pressure of the fluid in the mains therefore will remain constant.



Thorp's Pressure Equalizer.

The same arrangement would be used in the cases where air or gas is strongly compressed in the pump or blower and forced out through a back-pressure valve. The delivery pipe would be connected to the equalizing cylinder behind the valve, and its piston so actuated by a cam as to draw in the excess volume above the mean delivery after the valve has opened, and force this excess out again as the delivery falls below the mean and while the valve is closed.

Fig. 3 represents the application of the invention to a Beale rotary blower. Such a blower having an eccentric shaft with two sliding plates diametrically opposite each other rotating in a cylinder, the volumes drawn in and forced out for equal angular movements vary at the same rate during each half-revolution; and a curve representing the variations can be planned.

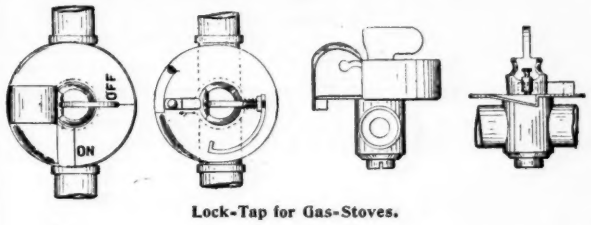
A is the shaft of the blower (not shown). The pipe B communicates with the suction pipe to the blower, and, through the pipe C, with the upper part of the cylinder D above the piston E; while the pipe F communicates with the delivery pipe of the blower and opens into the bottom of the cylinder D below the piston. The piston is connected to one end of a U-shaped leather packing ring, the other end of which is fixed to the bottom of the cylinder, so as to obtain a frictionless working of the piston. The piston rod is connected by a forked cross-head and pin to a lever G, the other end of which rocks on a pin, which can be adjusted and fixed in horizontal slots of the forked standard to effect some adjustment of the piston stroke, the lever having a corresponding slot and lateral projections, which bear upon both rounded ends of the standard and secure the lever in its longitudinal position, while the bolt H can be shifted in the slots of the lever and standard. Below the centre of the shaft the lever is fitted with a roller I, held against the double-throw cam J by the pressure of the gas on the underside of the piston, which communicates with the delivery pipe, in which the pressure is greater than in the suction-pipe communicating with the top of the piston. The cam is shaped and set in accordance with the curves above and below the mean volume line in the volume diagram; and the cylinder and piston stroke are of such dimensions that the cylinder takes in, or forces out, at each part of its stroke a volume equal to that drawn in or forced out at the same time by the blower in excess of the mean volume. In this way the rate of flow and the pressure in the suction and delivery mains remain quite constant, "whereby the danger of injury to which station-meters used in connection with exhausters not provided with an equalizer are exposed to is entirely obviated."

Lock-Taps for Gas Fires, Stoves, &c.

WILSON, H. F. (Wilsons and Mathiesons, Limited), of Leeds.

No. 11,731; May 21, 1907.

This invention relates to a tap which, when turned off, is automatically locked, and can only be turned on by a person in possession of the key necessary for the withdrawal of the locking bolt, though the tap may be regulated within reasonable limits without the shutting off of the gas supply. It is intended primarily for use with gas-fires in hotels or the like, with a view to preventing unauthorized persons using the fire or turning on the gas.



Lock-Tap for Gas-Stoves.

Attached to, or forming part of, the supply pipe containing the usual plug or tap aperture is a plate of suitable configuration (as shown), provided with means whereby a cover may be attached to it. Through the tap plug—by preference, above the gas-way, and above the surface of the plate—is placed a spring bolt, provided towards one end with a "talon," whereby the bolt may be moved by the "bit" of a key; and in or towards the same end of the bolt there is placed a spring stud, which, when the bolt is moved by the key, tends to fall into a groove, or its equivalent, formed in the plate—the groove being formed taper from the level of the plate downwards, and in the shape of a segment of a circle. The other end of the bolt, when the tap is closed, projects into a recess or opening made in an upstanding flange formed on the plate. This flange acts as a guide for the bolt, and also as a stop when the tap is open. The plate, plug, and lock bolt, are enclosed by a suitable cover having thereon letters to show whether the gas-way be open or shut.

Should the tap be in the "off" position, the locking end of the bolt rests in its socket in the plate, flange, or the like, and cannot be withdrawn without the aid of a key. On the "bit" of the key operating the "talon" of the bolt, the bolt is withdrawn; and the spring stud will fall into the recess or groove in the plate. On the tap being turned, the spring stud will gradually reach the level of the plate; and when the tap is quite open, the locking end of the bolt is prevented from moving further by a projection or stop formed on the plate or on the plate flange. When the tap has been shut, the locking end of the bolt will, by reason of the spring on the bolt, enter its socket, and the key will again be required before the tap can be turned on.

Separating the Constituent Elements of Gaseous Mixtures.

MAZZA, E., of Turin.

No. 13,598; June 12, 1907.

This invention relates to improvements in the separator described in patent No. 7421 of 1906*. The improvements bear chiefly on the determination of the relative dimensions of the parts of the apparatus, on the form and arrangement of the partitions or diaphragms, on the determination of the proportion between the sections of the outlet apertures for the heavy and light gases, and on a means for increasing the output of the separator by introducing the gaseous mixture into the rotary separator under pressure. The present improvement also comprises means for increasing the centrifugal force acting on the gaseous molecules, and therefore the output of the apparatus, by first compressing the gaseous mixture which it is intended to separate, and thereafter allowing it to expand into the separator. The speed then attained by the mixture is due to the pressure under which it enters the separator, as well as to the rotary action of the latter. In such case the difference in the relative densities of an inside and an outside layer between two diaphragms is increased, and the separation is said to take place more rapidly, and in a more thorough manner.

APPLICATIONS FOR LETTERS PATENT.

7333.—MILLER, L. H., "Acetylene generators." April 2.
7366.—SHEARER, W., "Making air gas." April 3.
7367.—BLAKELEY, W., "Spraying tar on roads." April 3.
7369.—BURNETT, C., "Coal-conveyors." April 3.
7399.—RESTLER, J. W., "S reet boxes for cocks." April 3.
7442.—KIRKHAM, W., "Gas-heated furnace." April 4.
7461.—HANDCOCK, W. A., "Incandescent gas lighting." April 4.
7501.—MUMFORD, F., and ISRAEL, J., "Mixture for rendering coal or other carbonaceous fuel smokeless when ignited." April 4.
7541.—KEITH, J. & G., "Gas-lamps." April 6.
7545.—DASHWOOD, J. B., "Gas rings or stoves." April 6.
7548.—HELPS, G., "Gas lamps and burners." April 6.
7567.—SPARKS, E., "Gas-valve." April 6.
7582.—POTTERTON, T., "Combined gas and coal ranges." April 6.
7661.—WORRALL, T. F., "Acetylene generator." April 7.
7699.—HEATON, J., "Gas-generators." April 7.
7740.—MUNDLER, S., "Globe galleries." April 7.
7745.—JÖNSSON, A., "Generating acetylene." April 7.

* See "JOURNAL," Vol. XCV., p. 585.

7758.—Hird, H. P., "Productions of ammonia from ammoniacal liquor." April 8.
7791.—Podmore, A. E., and Thomas, J., "Inverted burners and lamps." April 8.
7840.—Larkin, C. J., "Lighting attachments for gas and acetylene burners." April 8.
7867.—Baxter, A. E., "Anti-vibrator." April 9.
7989.—Lemétais, J., "Combined gas and water valves for heating apparatus." April 10.
8000.—Chandler, D., "Discharge of coke from gas-retorts." April 10.
8004.—Haden, W. N., C. I., and Watts, C. J., "Ventilating radiators for gas." April 10.
8010.—Van Praag, D. J., "Acetylene burners." April 10.
8014.—Lymn, A. H., "Recovering ammonia from producer gas." April 10.
8080.—Weguelin, W. H., "Atmospheric gas burners." April 11.
8087.—Krause, P., "Suction gas installations." April 11.
8103.—Marcou, P., "Distillation of coal." April 11.
8104.—Michaud, G., and Delasson, E., "Filaments for illuminating and heating purposes." April 11.

LEGAL INTELLIGENCE.

FORMER BARRY GAS-WORKS MANAGER.

Action at the Glamorgan Assizes.

A case of considerable interest to those connected with gas and water undertakings was heard last Thursday week at the Glamorgan Assizes, held at Cardiff, before Mr. Justice Bray, when Mr. F. M. Harris, the former Gas and Water Engineer to the Barry Urban District Council, and prior to that for seventeen years Engineer to the Falmouth Gas Company, sued the Barry Council for £740 alleged to be due for commission on new works carried out under his superintendence.

Mr. John Sankey and Mr. Lovat Fraser (instructed by Mr. J. Arthur Hughes) appeared for the plaintiff; and Mr. Abel Thomas, K.C., M.P., Mr. Ivor Bowen, and Mr. Raymund Allen (instructed by Mr. T. B. Tordoff, Clerk to the Council), for the defendants.

Mr. Sankey, in opening the case, said that defendant had been Engineer to the private Company whose interests had been acquired by the Council under an Act of Parliament. According to the provisions of this Act, defendants were obliged to take over all the officials; and all contracts between the latter and the Company must be observed by the Council. Mr. Harris had a contract with the old Company to be paid a salary as Engineer and also the sum of 2½ per cent. commission on all new works erected. Defendants denied that there was any such agreement, and they also pleaded the Statute of Limitations. As far back as the year 1886, a Company was formed at Barry—just before the Barry Docks Railway Company obtained their Act of Parliament to construct the docks. This Company was called the Barry and Cadoxton Gas and Water Company. Nearly all the Directors were connected with Falmouth; and the Chairman (Mr. E. Handcock) was a well-known gentleman at both Falmouth and Cardiff, and had had some connection with the Falmouth Gas Company. The Barry Company were anxious to get the Manager of the Falmouth Company to superintend their works for them; and they deputed Mr. Handcock to see if he could obtain the services of Mr. Harris, who was at that time Gas Engineer at Falmouth. Correspondence was read, according to which the salary was fixed at £300 per annum; and Mr. Harris consented to come for this sum, *plus* 2½ per cent. commission on all new works. The minutes of the Company confirmed this; and between the date named and 1892 there were various large sums paid to the plaintiff as commission, all of which appeared in the Company's books. On account of the Water Engineer leaving the service of the Company, Mr. Harris was appointed to the dual position of Gas and Water Engineer at a salary of £400 per annum. In 1894, the undertakings were purchased by the District Council; and in reply to the Clerk of that body, Mr. Harris wrote giving a list of the salaries paid. In a later letter, Mr. Harris informed the Council of the arrangement in regard to commission; and there was a minute in October, 1896, when the consideration of the matter was deferred, but nothing was done. In conclusion, he (Mr. Sankey) submitted a list of new works Mr. Harris had executed—including mains, gasholder, retort-house, retort-settings, &c.

Mr. *J. B. Ferrier*, who was a Director of the Barry and Cadoxton Gas and Water Company, and was one of the original promoters, said he remembered distinctly that the arrangement with Mr. Harris was that he should receive commission.

Mr. Abel Thomas objected to any evidence being accepted outside what appeared in the minutes.

Justice Bray: If there is an agreement, evidence may be given of it, in the absence of any documents.

Mr. *Ferrier* (cross-examined) said that the minute raising the salary of Mr. Harris to £400 stated that this was the sum "fixed;" but that did not mean that it was to include commission. This was understood all along.

Mr. Thomas: Whether it was understood or not, from that moment you paid no more commission?

Witness: But he would be entitled to it.

From that time until 1894, considerable works were carried out?—I can't really remember.

Mains were being extended, as Barry was rapidly growing; and the sum of between £500 and £600 was paid to Messrs. John Aird and Sons for mains?—That would be for water-mains. Witness added that the Manager was paid the commission whenever he put in an account. He was not a very selfish man.

Mr. *J. Just Handcock*, solicitor, was also called as to the agreement entered into between the late Mr. E. Handcock (his father) and Mr. Harris, who induced the latter to leave Falmouth. The commission was distinctly to be paid.

Mr. *F. M. Harris*, the plaintiff, was called, and said that commission was to be paid for designing new works and superintending their erection. The original salary was £270, and a sum of £30 a year in place of a horse and trap; also 2½ per cent. commission for designing new works and superintending their erection. The new works would comprise retorts, purifiers, washers, condensers, exhausters, boilers, &c. When his salary was subsequently "fixed" at £400, as the minute stated, he had no idea that this should include the 2½ per cent. commission. In 1892, after the concern had been transferred to the District Council, an extension of the plant became necessary, and he prepared plans, specifications, and dimensions for this work in order to place them before the Local Government Board to secure the loan.

Cross-examined, witness said he had claimed commission on mains laid during the last six or seven years. He did not previously put forward his claim for commission to the Council because, being in a comfortable situation and officials were being harshly treated, it might have prejudiced his position. If he had made the claim, his position might have been endangered to a considerable extent. It was after receiving notice to leave their service that he sent the Council particulars of his claim. He had sent in a bill of expenses for preparing plans; and, notwithstanding this, he considered he was entitled to the 2½ per cent. commission.

Justice Bray: Why did you not let them know?

Plaintiff: I can't say.

Mr. Abel Thomas: They even recommended that your salary be raised to £450; and you did not mention it then. A bill was presented for £36 8s. 10d. for preparing plans, and also for £79 7s. 6d., and for travelling expenses. Certain of the plans were prepared by patentees for presentation to the Local Government Board.

Justice Bray: It would be part of your brief, Mr. Sankey, to have these plans here which your client has prepared. Have you them here?

Plaintiff: All my documents are in the hands of my Solicitor.

Justice Bray: Then if you do not produce them, I can only conclude that there are none.

Plaintiff said that, although no charges were made against him when he was given notice to leave, there was suspicion.

Mr. Abel Thomas: There are no charges against you. (To his Lordship:) There is also the question of the Statute of Limitations.

Justice Bray: You had better leave that question for the present. I do not see anything is proved after the old Company had departed. It certainly is a little vague to claim this 2½ per cent.

Mr. Sankey said his Lordship overlooked the evidence of Mr. Ferrier as to what the agreement was.

Justice Bray: Suppose I find that undoubtedly commission was earned and never asked for or obtained? Your own client puts it no higher than that.

Mr. Sankey: He was to have 2½ per cent. commission on all new work.

Justice Bray: I am not trying that. That has not been proved at all. It was proved that he was to have commission on certain work; but I am not satisfied it was to be upon all these works. I am not satisfied upon that point. Then he could have sent in his account with his reports.

Mr. Sankey: I should submit that if I can substantiate my claim up to March 18, 1894, then the contract continues. Perhaps the plaintiff may have done something afterwards which your Lordship is entitled to take into consideration.

Justice Bray: But he has not told the Council the terms of the contract once; not even when he was requested to do so. Here, again, there was no request to do this certain work. Continuing (in giving judgment) his Lordship said he was prepared to accept the statement as to what were the relations between Mr. Harris and the old Company; but this did not show that it was part of the contract that he could claim any commission. It could not, however, be inferred from subsequent correspondence that the plaintiff was to have commission; and if so, on what work was it to be received? There was a great deal of work done between 1891 and 1904 which would have made plaintiff entitled to £170 commission; but he did not enforce his claim, and this left the presumption that his salary was to be £400 and no commission. Judgment must therefore be given for the defendants, with costs.

MANUFACTURE OF THORIUM NITRATE.

Action for Wrongful Dismissal.

In the King's Bench Division of the High Court of Justice, Mr. Justice Lawrance and a Special Jury were engaged for several days just before the Vacation in hearing an action brought by Dr. Franz Frederichs against Messrs. Hopkin and Williams for damages for alleged wrongful dismissal. This was denied by the defendants, who said the plaintiff's engagement by them was subject to certain conditions which had not been fulfilled.

Mr. J. A. Simon, K.C., M.P., and Mr. R. B. Murphy appeared for the plaintiff; and Mr. E. Pollock, K.C., and Mr. Colefax represented the defendants.

Mr. Simon, in opening the case, said the plaintiff was a German chemist of great scientific attainments, possessing exceptional knowledge of certain branches of chemistry. The defendants were manufacturing chemists in Cross Street, Hatton Garden, London, who desired to make thorium nitrate, which had come extensively into use for the manufacture of gas-mantles. It was worth from 35s. to 40s. per kilo., and was made by a series of elaborate operations, all of which had to be very carefully carried out. The raw material from which it was produced was monazite sand, coming principally from Carolina and Brazil. When the plaintiff first communicated with the defendants, no thorium nitrate, so far as he knew, had been made in England. The defendants could not make it, as the process was

a secret one, known to the plaintiff, and only acquired by the defendants by getting him into their employ. In January, 1905, they entered into a contract that he should come over and make thorium nitrate for them. By this means they obtained from him the nature of the process; and after one of their employees had learned how to make the material, they dismissed the plaintiff, and were now using his process without paying him a farthing for it. In 1900, he had at Hamburg a business of his own for producing thorium nitrate; but a trust or ring was formed in Germany of certain firms who succeeded in making a "corner" in the raw material. This rendered things so exceedingly difficult for the plaintiff, that he gave up his business in Hamburg, and in the autumn of 1904 got into communication with the defendants. In the following January, he entered into the agreement on which the action was based, which provided that he should be manager of the defendants' works at a salary of £600 per annum, with a royalty of 6d. per kilo. up to 10,000 kilos. per annum, and 3d. per kilo beyond this quantity. The engagement was to be for one year from Jan. 1, 1905, and was to be continued thereafter so long as the defendants continued to make thorium nitrate. There was no provision by which they could get rid of him unless they ceased to make the stuff. It appeared that the manufacture was not successful, owing to the plaintiff not being supplied with proper sand or suitable plant for carrying out the process. After two years, the defendants dismissed the plaintiff, though they had no right to do so according to the agreement, because they continued working the process under the direction of the plaintiff's late assistant, whom they were paying £250 a year.

Plaintiff was called, and gave evidence bearing out the statements of the learned Counsel.

In cross-examination by Mr. POLLOCK, plaintiff would not admit that he could not make a single kilogramme of thorium nitrate which defendants could sell, or which was at all saleable. He asserted, on the contrary, that he produced thorium nitrate which was of a proper marketable colour, though he admitted that some of it was of reddish colour, and that he experimented to get rid of it. He asserted that whatever defects existed were due to impurities in the sand supplied, and to the inefficient plant.

Mr. POLLOCK said it was true that the defendants wanted a competent chemist who would be able to use his skill and knowledge to overcome any difficulties which might arise; but they certainly did not admit that there was any secret process, or anything which involved plaintiff's personal knowledge. They retained him in order that he might give them a specification of the plant required, and an estimate of the cost of production. He was also to supervise the purchase of the materials, and see that they were manufactured properly. The defendants put down the plant exactly as the plaintiff required, and had spent what money he asked for. The plaintiff said he could produce 60 kilos. a day at a cost of 10s. per kilo.; but from June, 1906, to May, 1907, the thorium produced cost 19s. 6d. per kilo., and only 1953 kilos. were produced altogether. The plaintiff had an absolutely free hand, and all his requisitions were complied with. After two years, he had entirely failed to comply with the conditions named in the agreement; and defendants were absolutely justified in ending it.

Mr. *Alfred Howard*, the Chairman of Directors of the defendant Company, and of Messrs. Howard and Sons, chemical manufacturers, said that since the plaintiff had left they had been treating again the thorium which he had made, with a view to making it marketable; and they were turning out from 25 to 30 kilos. a day. The manufacture of the article by the plaintiff was a source of considerable loss to them, and they could sell none of the stuff he made. It was quite untrue that they got rid of him in order to work his process themselves. He did not think the plaintiff was a competent chemist for the manufacture of thorium.

Mr. *Edmond White*, the defendants' Manager, said that since the plaintiff left they had continued working his process with a slight modification, and had succeeded in getting satisfactory results. The modification was one which any chemist ought to have been able to find out, and it took only one day in the laboratory and another in the works to complete. All that was necessary was to put a little nitre into the liquor when breaking the sand; and the success of the operation depended upon a process which the plaintiff did not know. Plaintiff's thorium always contained lead, and when it was used for incandescent mantles it turned them red, rendering them unsuitable for sale. The defendants had made it much whiter.

In cross-examination by Mr. SIMON, witness would not say that the plaintiff's services had been worthless. The process was not a secret one, because it had been used by two firms on the Continent, in one of which the plaintiff was a partner. He did not know what plaintiff's process was until the contract with him was signed. Mr. A. Pattison was now the Works Manager, having been under the plaintiff until he left. Witness thought Pattison learned what he knew now since the plaintiff had gone. The plaintiff ought not to have sent out thorium nitrate which had lead in it, as he had guaranteed pure thorium. The sand used came from a French Society, and produced a darker liquid than other sorts. Plaintiff asked to be allowed to use Carolina sand; but the defendants refused, considering it a waste of time. Witness and Pattison together solved the difficulties after the plaintiff had left; but they had not made good thorium on a commercial scale and they had treated 2 or 3 tons of sand in the past six months. He admitted that nearly all the sand he treated was Carolina sand, whereas the plaintiff used Brazil sand. He declined to let Counsel see the process he now used, as it was a secret one. Thorium produced by the plaintiff had been treated again by the defendants with success.

Mr. *Alex. Pattison*, Assistant-Chemist in defendants' employ, said he was now in charge of the process for the manufacture of thorium nitrate at their place. The pipes at present used were in exactly the same position as they had been all along. If he had gone on using the plaintiff's process, he would not have succeeded in getting good thorium. He tried one lot by it, and the yield was bad and the quality poor. The success had been the result of the alteration which he had made in the process.

In cross-examination, witness said he was 28 years of age, and was apprenticed to a pharmaceutical chemist. He had met the plaintiff several times since he left the defendants' works, and the plaintiff might have suggested further treatment of the oxalates with carbonate of ammonia; but this was a very obvious thing to do. Probably Dr. Frederichs was a competent chemist in many ways; but he could not be competent in every direction.

Mr. *Otto Hehner*, Analyst to the South Metropolitan Gas Company, said there were a great many processes for getting thorium from monozite sand, and he knew many of them, but not the plaintiff's. He had seen some of the sand used by the plaintiff, and had broken it by the usual process, and produced a very good thorium from it. At first the liquor was very dark, like that made by the plaintiff; but it was further heated, and more sulphuric acid put in, and then it became of a satisfactory colour. The sand given to the plaintiff was quite suitable for the production of thorium, if properly treated. It was not possible for the defendants to compete in the market with the thorium made by the plaintiff against that produced by other firms.

In cross-examination, witness admitted that a chemical success might not always be equivalent to a commercial one. The amount of cerium left in the plaintiff's thorium showed that it had only been imperfectly treated. He did not believe the South Metropolitan Gas Company would use the thorium turned out by the plaintiff.

The evidence of M. Paul Singer, of Paris, taken on commission, was read. He said he was the agent of the Society who sold to the defendants the sand given to the plaintiff; and so far as he knew, no difficulty was ever found in extracting good thorium from it. He had never heard of any complaints of the sand.

Some further evidence having been given, Justice Lawrance summed up; and the Jury returned a verdict for the plaintiff, with £500 damages. His Lordship having then left the Court, judgment will be applied for at the next sittings.

COMPENSATION CLAIM FOR GAS POISONING.

Action against the Gaslight and Coke Company.

At the Brompton County Court yesterday (Monday) week, before his Honour Sir WILLIAM SELFE, Frederick Bassett, a builder and decorator, of Epple Road, Fulham, and his wife, jointly brought an action against the Gaslight and Coke Company to recover £50 damages for personal injuries sustained through the alleged negligence of the defendants' servants.

Mr. J. P. OLIVER was counsel for the plaintiffs; Mr. A. NEILSON represented the defendants.

The plaintiffs' case was that they had occupied the house in Epple Road for nine years, without ever using gas. On Jan. 13 last, they retired to rest as usual; but woke during the night and found the room filled with gas. Mr. Bassett got up, and went down stairs; and, after opening some of the windows, he returned to the bedroom, where he found his wife in a state of stupor, and carried her down to the kitchen. All the doors and windows were then thrown open; and Mr. Bassett and his wife sat up the whole of the night. In the morning, he sent the following telegram to the Company: "Escape of gas from main. Come at once. Dangerous." Later in the day, several of the Company's workmen arrived on the scene, and took up the road; and Mr. Bassett then saw (as he alleged) a crack in the gas-main sufficiently wide for a man's finger to pass through it. The workmen bound up the pipe with tallow, white lead, and pieces of cloth and yarn; and then he filled in the excavation and went away. According to the plaintiffs, however, the escape of gas continued and filled their house; and a second communication was then made to the Company, who, two days after the first visit, sent more men, and a portion of new pipe was substituted for that which was fractured. This, the plaintiffs contended, should have been done in the first instance. As it was, both Mr. Bassett and his wife were laid up, and had to consult a medical man and employ other persons to perform their duties.

Mrs. Bassett, in her evidence, said she had received treatment from a doctor up to the present time, owing to pains in the head; and Dr. Phillips gave evidence to the effect that her symptoms were consistent with gas poisoning, though he did not describe her case as serious.

For the defence, a number of the Company's employees were called, and stated that the work of repairing the main was done most effectually; and that when called a second time, the examination showed that there had been no further leakage. A service man named Skinner said that the main when it was repaired received a coating of grease and white lead; and a specially prepared calico bandage was afterwards bound round it. A very delicate instrument (a gas-leakage indicator) was then used to test whether there was any escape, and a naked light was also applied; but no leakage whatever was discovered. An assistant foreman named Tomlinson said he visited the plaintiffs' house on Jan. 16, when Mr. Bassett told him that there was still a strong smell of gas in the cellar; but when he went to the spot, witness found no indication of it. Mr. George Marvin, one of the Company's Divisional Inspectors, also said he discovered no smell of gas when he went to the plaintiffs' house on Jan. 16. On the road being taken up the second time, not only was the leakage indicator used as a test, but the workmen applied their noses to the main without discovering any escape of gas. The Company had 2000 miles of mains in London; and the indicator was the best test they had. He could not account for this particular pipe becoming fractured, but thought it might have arisen from the traffic—probably the motor traffic—in the road above. Dr. Hastings, Consulting Physician to the Company, said he had examined the plaintiffs, and was of opinion that neither of them had inhaled any large quantity of gas.

His HONOUR, in summing up, said that if the workmen did not properly repair the gas-main on their first visit, then the Company must be held responsible; but, on the other hand, if the fracture to the main was effectually repaired, and no escape of gas followed, then it could not be held that there had been negligence on the part of the Company's employees.

The Jury, after a short consultation, returned a verdict in favour of the Company.

Impudent Theft of Gas-Fittings.

At the Devonport Quarter Sessions, a few days ago, Thomas Rowe, a labourer, was indicted for stealing lead piping and gas-fittings, and also 7s. in money, belonging to the Devonport Corporation. It appeared that on the 19th of February a Mrs. Phillips vacated a house in Edinburgh Road, leaving it locked up securely. On the 22nd, a policeman found the front door unlocked, and on going in to investigate the matter, he discovered a prepayment meter lying in the passage with the empty money-box separated from it. The connecting pipes had been cut, and gas from the service-pipe was escaping. On the landing upstairs were two other meters, which had also been tampered with; the money-box of one having been detached. Some of the gas-fittings in the house had been torn down. About the time this discovery was made, another policeman met the prisoner and a man named Smith carrying a heavy bag and crying "Rags and bones." On looking into the bag, the policeman saw lead piping and brass fittings. Prisoner ran away; and the other man, after pretending that the things had been given to him, also attempted to escape, but was caught. Rowe was apprehended. When before the Magistrate, the men accused each other of the robbery. Smith was summarily convicted. Rowe was found guilty, and sentenced to six months' imprisonment.

Alleged Deficient Water Pressure at a Fire.

At the Caversham Petty Sessions, recently, the South Oxfordshire Water and Gas Company were summoned by Mr. M. G. Roper, of "The Grange," Goring, for neglecting to keep charged with sufficient water the pipes to which fire-plugs are affixed. According to the opening statements by Counsel, a fire broke out in the stables belonging to Mr. Roper. An alarm was given, and the fire brigade arrived; but, owing to the inadequate pressure of water in the mains, it was impossible to cope with the fire. Mr. George Ellis, the Captain of the Goring Parish Council Fire Brigade, said he received a call to the fire, and was soon on the spot with his men; but the water pressure was very bad—the jet thrown being not more than 15 or 20 feet. All the stables were burnt down. Mr. Cecil Walsh, who appeared for the Company, said the Directors were most anxious that there should be no unpleasantness with the consumers. With regard to the prosecution, there was no case for him to answer. In the first place, the summons was taken out under the wrong section of the Act of Parliament; and even if this were not so, no evidence had been called as to the pressure by gravitation from the reservoir, which was necessary to prove the case. Further, there were some special circumstances which exonerated the Company from liability. The Bench having conferred in private, the Chairman said the summons would be dismissed. The Magistrates were, however, sorry to say they believed that there was a feeling of distrust as to the conduct of the Company's business; and they were glad to hear the assurance that the Company were really anxious to satisfy their customers. The Chairman of the Company said that nothing would please them better than that distrust should disappear altogether, with any unpleasantness that there might be in the district. Mr. Brain, for the complainant, said his client was quite satisfied with the decision of the Bench; and if effect was given to the expression of the Chairman of the Company, his object in bringing the case forward would have been accomplished.

Serious Charge against Kent County Gas Company Promoters.

At the London Bankruptcy Court, on Tuesday last week, before the Senior Official Referee (Mr. E. Leadam Hough), the first meeting of creditors was held under a receiving order made against Walter Darby, of No. 20, Great Winchester Street, E.C. The debtor, it will probably be remembered, was one of the promoters of the Kent County Gaslight and Coke Company, Limited. He was not present at the meeting; and Mr. Dade, his Solicitor, explained that his absence was due to certain Police Court proceedings. The Official Receiver adjourned the meeting till the 23rd inst., and intimated that the debtor must attend in the meantime to give information regarding his assets and liabilities. The proceedings referred to consisted of a summons taken out against the debtor and Henry Warwick Gyde (otherwise Peter Henry Barnard) by Mr. E. V. Fox, the Examiner in the Companies Winding-Up Department of the Board of Trade, for conspiring with Septimus Marcus (otherwise Marcus Edward Septimus Bernard) to obtain by false pretences moneys and valuable securities from such persons as should be induced to become debenture-holders in the Welsh Slate Quarries, Limited, and the North Wales Quarries, Limited. The case came before Alderman Sir James Ritchie on Tuesday; but when it was called on for hearing, it was stated that Darby was not in attendance. Mr. George Elliott, who appeared for him, said he thought he ought to call Mr. Darby's Solicitor, so that the Court might hear from him exactly when he saw Mr. Darby last. He hoped that nothing unfortunate had happened; but it was very strange that Mr. Darby was not there. There was no question of his absconding. Mr. Dade said his client was served with the summons a week ago, and was quite prepared to meet it. He was with him at half-past seven on Monday evening, when he was fully prepared to come to the Court that (Tuesday) morning. He slept at the house of his brother-in-law on Monday night, and left there at 8.30 that morning to come to the City; and he (Mr. Dade) had ascertained that he had been to an office in the City, but since then he had not been heard of. The service of the summons on Darby having been proved, Mr. Graham Campbell, who appeared for the prosecution, applied for a warrant for his arrest; and Sir James Ritchie intimated that he would grant it. The summons against Gyde was then adjourned till the 28th inst.; he being admitted to bail in his own recognizances in £2000, and in two sureties of £1000 each, or one in £2000.

Late in the evening last Saturday week, the Pontlottyn gas supply failed, and for a time tradesmen had to resort to candles. The Gas Company's officials promptly rectified matters; and the supply was restored in twenty minutes.

MISCELLANEOUS NEWS.

RIVER PLATE GAS COMPANY, LIMITED.

Business Expansion—The Municipality and the Gas Supply of Buenos Ayres.

The Annual General Meeting of the Company was held last Wednesday, at the River Plate House, Finsbury Place—Mr. A. E. Bowen in the chair.

The Secretary (Mr. H. T. Adkins) having read the notice calling the meeting, the Directors' report and the statement of accounts were taken as read.

The Chairman, in moving their adoption, said the Company had had another prosperous year; and he was sure the shareholders would consider the figures very satisfactory indeed. It was quite true the profits showed a slight falling off from the record of the previous year —£129,325, against £135,114. But £6506 more had been spent in upkeep than in 1906—£20,718, against £14,112. The revenue account was charged with the whole cost of dismantling and erecting on a larger scale section No. 4 of the retort-benches at the Corrales works—say, some $50,000 paper. There had also been paid out of revenue the labour charges on the new water-gas plant at Corrales; so that the difference in the net profit item was more than accounted for. They had also to face the strike of the men at the Corrales works in February last year; and, although with the assistance given to the Company by the Government, and the energetic measures taken by the General Manager and the Chief Engineer, they were able to keep the works going, and eventually break the strike, the cost was upwards of £1000. The Directors did not anticipate any more trouble of this kind, as the men now seemed quite happy and contented. But the Board were continually putting into the works labour-saving appliances, in order to make sure. Then coal had been very dear; and freights outwards ran up to figures that had not been seen for some years, so that their 50,000 tons of coal cost at the works 2s. 6d. per ton more than in 1906, or (say) £6250. Although coal prices had not dropped as much as they could have wished, freights were distinctly in their favour; and so, in all probability, the current year would benefit considerably in this respect. The great prosperity of the Argentine Republic was now almost proverbial. The city of Buenos Ayres continued to expand and flourish; and the Company were getting their fair share of these good times. During the year they obtained a record number of new customers; no less than 3404 new services having been connected with the mains—that was to say, after deduction of services taken out for one reason or another. The Directors had been obliged to go to considerable expense in laying high-pressure mains to supply the somewhat distant (from the works) districts of Velez Sarsfield and Villa Urquiza, as the Company were getting constant complaints about the want of pressure at these extreme ends of their main system. Therefore they had put in, at a cost of upwards of £8000, high-pressure mains, and bought two plots of land in Flores and Villa Urquiza to use as governor stations. He was glad to say that, in consequence of these improvements, the pressure in the outlying districts was as regular and satisfactory as in any other part of their extensive system of 451 miles. Altogether, during the year, no less than 21 miles of new mains were laid. They also actually sold 7·27 per cent. more gas in 1907 than in the preceding year; and this on top of an increase of 8·70 per cent. in 1906. But perhaps even a more satisfactory consideration was that the increase in gas supplied to private consumers over 1906 was no less than 11 per cent.; and this notwithstanding the decreased consumption resulting from the now almost general use of incandescent burners. In the year, the Company themselves imported and manufactured no less than 131,000 mantles. These increases were being fully maintained this year. The volume of gas supplied for other than lighting purposes was 25·23 per cent. of the total sales, against 20·98 per cent. in 1906. They had over 4750 cookers and grillers hired out to customers on Dec. 31 last, and attended to the lighting of 8118 public lamps—an increase of 452 over 1906. The shareholders would judge from what he had said that the business continued to expand in a most gratifying manner. The past year had been a very anxious one, both for the Directors and for the officials in Buenos Ayres, as the agitation among the municipal authorities for a reduction in the selling price of gas took an acute form. There had always been more or less trouble in this respect since he became acquainted with the gas industry in Buenos Ayres; and he thought that was in the year 1886. But the Company had always been able to carry on their business. Only once had they had really serious trouble with the authorities, and that was in 1891. This trouble was settled by the Companies consenting to allow the municipal authorities to intervene in fixing the selling prices. And eventually the sliding-scale under which they had been working was arrived at in 1896; and they had hoped to have been allowed to continue to work under it. But the municipal authorities succeeded in forcing the German Electricity Company, by far the largest lighting and power company in the Argentine, to agree to a municipalization scheme, by which the selling price of current was fixed (and at what he and his colleagues thought was a reasonable price), and the whole of the properties of the Company were to revert to the commune at the expiration of fifty years, free of all costs and charges. After this success, the authorities, naturally, turned their attention to the Gas Companies, and put on all the pressure in their power to induce them to consent to an agreement of the same kind, but unfortunately on the basis of extremely low selling prices. The Directors saw plainly that they must come to some definite arrangement; and they assured the Lord Mayor that they were prepared to treat with him and meet him to the best of their power, consistent with their duty to the shareholders. But the extreme element in the Municipal Council threatened them with all kinds of pains and penalties. They wished to fix the selling price of gas at figures which would have meant the complete and utter ruin of the Companies—indeed, would not have allowed them to pay even their debenture interest. The Directors were therefore

compelled to stand firm, and state that, while still disposed to negotiate on a reasonable basis, they were prepared to appeal to the Supreme Court of the Republic if any attempt was made to coerce them into accepting ruinous prices for their product. This went on for some four or five months, during which the Company's Local President and the General Manager were in constant touch with the authorities, and were doing all in their power to arrive at an agreement. But just at the end of the year, when the Municipal Council were about to leave office, the extreme element succeeded in getting an "ordenanza," or decree, passed, fixing the selling price of gas on a very low sliding-scale, and giving the three Companies a precarious concession for ten years under this scale. The Directors, of course, and one of the Company's friends and neighbours, refused to accept this decree; but one of the Companies, in order to avoid coming under its regulations, agreed to an ad-referendum contract with the Municipality, by which the selling price of gas was fixed at a higher price than the maximum figure of the referred-to decree. But the whole of the properties of the Company were to revert to the commune at the end of fifty years, free of cost; while in the meantime the dividends were to be limited, and all sorts of other objectionable clauses were introduced. This, of course, was an unpleasant surprise for the Board, and also for the Directors of the other Gas Company. But they both refused to agree to submit anything of the kind to their shareholders, as they did not consider the terms just or fair. The shareholders would quite understand that the Directors did not like the position at all; but being, as they were, firmly convinced that the authorities had no legal right to fix their tariffs without their intervention, they refused to have their hands forced, and instructed their lawyer to appeal to the Courts against the municipal decree. Then the Directors instructed their General Manager (Mr. A. Gabarret) to come to London to confer with them, and one of the other Companies also got their Manager home. The Directors had always been most friendly with the other two Gas Companies; and they had consulted with them about matters affecting the gas industry. Therefore, plainly, the best thing to do was to confer together; and the result of their protracted conferences was that the Company which had made the ad-referendum contract decided to cable out to Buenos Ayres that they found it quite impossible to carry it out. They retired from it; and this it was pretty evident to the Board from the time the contract was made would have to be the result. He must say here that he felt sure the contract in question was made in all good faith, and with the idea that it would prevent the obnoxious decree being passed, and would be of advantage to all three Companies. Then, with the assistance of their General Manager, the Directors drew up an ad-referendum project to submit to the authorities, by which they fixed the selling price of gas at a reasonable figure; and the Company undertook to band over the whole of their property and plant at the end of fifty years free of cost to the commune. Of course, the Directors stipulated for proper recognition for any fresh capital it might be necessary to put into the business during the fifty years; also that the reserve and other funds should belong to the present shareholders. The other two Companies had agreed this project with the Board—indeed, it was the result of their joint deliberations. He was of opinion that the authorities would accept this proposal, which was extremely favourable to them; and it was the best they could do. He was confirmed in this opinion by a cable received the previous day from their Local Committee, which was as follows: "Intendente has passed message to Concejo, demonstrating necessity proroguing date of ordinance, in order to allow sufficient time to study new proposal. We have found good disposition on the part of the Intendencia and Concejo. We hope prorogue will be considered during next week." Needless to say, the shareholders would be at once advised when anything definite was arrived at, and would be called together to receive full explanations of the contract, and its probable effects on the business. He need only add that the proposal fully protected the Company's interests. It would not, the Directors hoped and thought, have the effect of reducing the dividends; it would put the Company on an absolutely stable basis for fifty years, by which time the capital would have been completely amortized; and they would have the reserve and other funds intact. He had taken up much time with this matter; but his excuse was that it was of supreme importance to the interests of the shareholders. Before concluding his remarks, he compared the main items of the accounts with those for the previous year. Coming to the appropriation of the balance of the profit and loss account, he said the Board proposed to add £20,000 to the reserve fund, making it £185,000; to give £2052 to the old age and pension fund, making it £5000; and to pay a final dividend of 9s. per share, tax-free, making 8 per cent. for the year, because 1s. extra interim dividend was paid in October. This would leave £27,794 to go forward to the current account.

Mr. C. P. OGILVIE seconded the motion.

Mr. EDGAR H. SAMUEL asked what the part of the reserve fund which it was proposed to realize would be invested in.

The CHAIRMAN replied that it would go into mains, meters, and services. The capital account was about exhausted; and when they got through the trouble with the Municipality, the Directors would decide what they would do in regard to capital—whether they would call up more, or sell further securities.

The motion was unanimously carried.

Proposed by the CHAIRMAN, and seconded by Mr. J. M. TULLOCH, a final dividend was declared at the rate of 9s. per share, making 8 per cent. for the year, free of income-tax.

The retiring Director (Mr. Tulloch) was re-elected, on the motion of the Chairman, seconded by Mr. OGILVIE; and the Auditors (Messrs. Welton, Jones, and Co.) were re-appointed, on the motion of Major W. J. FOSTER, seconded by Mr. A. K. STANHOUSE.

The CHAIRMAN moved, in highly appreciative terms, a vote of thanks to the Secretary, the London staff, the Chairman and members of the Local Committee, and the General Manager, Engineer, and staff in Buenos Ayres.

Mr. C. J. HOLLIS seconded the motion; and it was cordially passed.

The SECRETARY having responded on behalf of himself and all comprised in the resolution,

A similar compliment was paid to the Chairman and Directors, on the motion of Mr. GEORGE LYDDON, seconded by Mr. W. R. HALL-CAINE—the latter remarking that he hoped the concession of the fifty years to the Municipality would not result in a fresh revision in (say) five or ten years' time.

The CHAIRMAN, in the course of his reply, said he was pretty certain they would get to the end of their trouble with the Municipality within the next few weeks; and this time it would be the end, because the project sent out was the one they meant to stick to. As soon as possible a meeting of the shareholders would be called to consider the terms of the proposed agreement.

PUBLIC LIGHTING IN PADDINGTON.

Improved Gas Lighting for the Harrow Road.

At a Special Meeting, the Paddington Borough Council decided the question of the lighting of a portion of Harrow Road, which has been under consideration for some time. The Metropolitan Electric Supply Company, Limited, and the Gaslight and Coke Company lighted, as an experiment, certain lengths of the thoroughfare named, for the purpose of comparison between the existing and the proposed gas schemes with the proposed electric flame arc lamp scheme. The cost of the present system of gas lighting is £198 per annum—*i.e.*, 66 lamps at £3. The Gas Company offered an improved system on the following terms: 66 lamps at £4 12s. 6d. each, or £305 5s. per annum, and no initial cost. If the lamps were taken over from the Company at the end of five years, the Council would pay £164; but in the event of the proposed arrangement lasting for ten years, the lamps would become the property of the Council without payment. The lamps would consist of two Kern burners in improved lanterns. The Electric Supply Company offered an improved system of 24 flame arc lamps, at an average of £13 each, or £312 per annum. The initial cost would be about £170; and the offer was made on the understanding that the arrangement would be in force for seven years. The Works Committee of the Council recommended the acceptance of the offer of the Electric Supply Company. The Finance Committee observed that the proposal opened the question of electric lighting for the whole borough, which would involve additional expense.

The recommendation was opposed by Mr. Beverley, who said that in the present state of the Council's finances they ought not to embark upon such a costly scheme. He pointed out that the Council had already experimented with electric light, and had given it up because it was too costly. Mr. Fairbank moved an amendment in favour of carrying out the improved system of gas lighting offered. He said that the part of the Harrow Road proposed to be lighted was three-quarters of a mile long, and was regarded as a "first-class" road for the purposes of the Lighting Department. There were 12 miles of first-class roads in the borough; and this gave some idea of what the cost would be if they were lighted as suggested by the Committee. Mr. Blackwood seconded the amendment. Alderman Whur, in support of the recommendation, observed that a deputation of tradesmen who waited on the Council suggested electric lighting, and since then a a memorial had been received to the same effect. Several tests had been carried out, and there was so little difference in the cost between gas and electric lighting that he thought the latter the more desirable. He did not think gas lighting would improve the illumination of the road. The amendment was ultimately withdrawn, and the Committee's recommendation to adopt electric lighting was lost by a large majority.

HEREFORD CORPORATION GAS SUPPLY.

New Public Lamps—Repairs at the Gas-Works.

At the last Meeting of the Hereford Town Council, the Gas Committee presented a report in which they recommended the Council to apply to the Local Government Board for permission to borrow a sum not exceeding £2000, repayable within ten years, for the following purposes: (1) Purchase of new lamps for public lighting, (2) paving of the coke-yard, (3) repairs of gasholders, and (4) repairs to the railway siding at the works.

In moving the adoption of the report, the Chairman of the Committee (Mr. Charles Witts) said the important part of it was the clause referring to the proposal to borrow money for the gas-works. He thought the Council must appreciate one fact with regard to the works, and that was that they had been in existence for something like thirty years, and therefore the Council must look forward to some expenditure in the future—he meant more than had been the case during the past few years. The life of the machinery and apparatus at the works was not more than thirty or forty years; therefore they would want renewals, and perhaps extensive repairs would have to be carried out. He was not by any means sounding an alarmist note; but he thought it would be a wise policy on the part of the Gas Committee to keep the works in proper condition and order. In regard to the gasholders, they were painted from time to time; but during the last few months they had been discovered to be somewhat worn. The Manager (Mr. W. W. Townsend) had been testing the cup-plates, and one was in such a worn condition that his finger went through it. If this was not a disastrous result, it was a by no means pleasant one. Some money would therefore have to be spent on the gasholders in the immediate future, and also on the railway siding and the coke-yard. He now came to an important question—that referring to the purchase of new public lamps. It was discussed at the December meeting, and it was then pointed out that the provision of new lamps was really a question for the Gas-Works and Lighting Committees combined. He thought, however, they would agree with him that if these Committees were called upon to provide a sum of money for the purchase of 600 or 700

new lamps, the cost would have to come out of the improvement fund, and that fund was already in a bad state. They could not afford to burden it with the cost of this number of lamps. There were 755 lamps in the city, and 109 were new. The 646 old lamps cost something like £200 per annum to keep in repair, because they had got into a bad state. As a matter of fact, they cost £193 16s. last year. The Gas Committee recommended that this amount should be utilized yearly in order to purchase new lamps. It represented one-fifth of the whole amount, because between 600 and 700 lamps would cost £1000. The Committee, in accordance with a resolution passed, proceeded to deal with the matter on these lines—*i.e.*, to renew yearly one-fifth of the whole; and samples of lamps were forwarded. They then found they could get very low terms indeed—much better than they had anticipated—owing to the low price of copper. They had negotiated with the manufacturer, with the result that if they bought the whole of the lamps in one batch, and not one-fifth as proposed, they would get far better terms. The Committee communicated with the Local Government Board, and asked if they would grant a loan for the purchase of the lamps and other suggested repairs; and, to their astonishment, the Board offered no objection. What they now suggested was this—that instead of spending £200 a year in repairing old lamps, they should borrow sufficient money, for ten years only, to purchase the whole of the necessary lamps during the coming year, or as soon as they could. It worked out in this way: If they renewed one-fifth of the lamps, as suggested at the December meeting, it would cost £200 per year; but if they borrowed £1000 for ten years, it would only cost £100 a year and the interest on the amount actually borrowed, and therefore the Committee asked the Council to sanction the arrangement.

The motion having been seconded by the Deputy-Mayor (Mr. G. J. Caldwell), who presided, Mr. Truman Cook said he thought Mr. Witts had taken the right course in purchasing the whole of the lamps, in view of the present state of the market. With regard to the repairs, it inevitably followed that there would be a considerable expenditure on renewals, particularly on gas-works which had been erected for something like thirty-four years. He thought such a period was about the lifetime of works of the kind. He also could not help congratulating him in coming forward in a time of emergency, and supplying gas when other lights failed.* Mr. Moore said the Council were all much indebted to Mr. Witts for the time and trouble he devoted to the gas undertaking. As to the repairs at the works, it seemed to him they had got into the position when they would have to spend a great deal of money on various matters. All these were repairs or renewals, and he would like to know why there had not been a renewal fund provided. Whenever he raised this question on the Electric Lighting Committee, he was told there was no necessity for such a fund, because they always had the renewals charged to revenue as repairs. It was a question of sound finance that some of the items included in the £2000 should be provided for out of a renewal fund; and a fund of this sort should have been established. Mr. Langford said he should have thought as most of the things referred to were repairs, the money for them ought to have been found out of revenue. He should have liked to hear Mr. Witts's opinion as to the advisability of lighting some of the principal streets by electricity. He was quite sure there were influential people in the city who agreed that the electric light was the best. Did Mr. Witts think it advisable, in view of the progress electric lighting had made in the city, to spend so much on gas-lamps?

Mr. Witts, referring to the last remark, said he was very sorry for the progress the electric light made on the previous Saturday night. Replying to Mr. Moore, he said he should not be surprised if some of the items notified were refused when a loan came to be asked for. He quite agreed that repairs should come out of revenue, and, as a matter of fact, this had always been done. Mr. Moore and other gentlemen must bear in mind that the present generation had paid for the gas-works; and he (Mr. Witts) was not going to suggest that they should purchase other gas-works and hand them on to their successors. The true course was to keep the works in a proper state of efficiency. It was not long ago that the ratepayers finished paying off the £55,000 loan; and in another three years they would have discharged the other loan of £30,000; so that in three years' time they would have £1000 additional income. It would then be for them to say whether or not the £1000 should go towards repairs. The present ratepayers had paid an enormous amount for the gas-works, and would soon be handing them over free to the city; and he thought they had done very well. In reply to Mr. Langford, he warned the Council—and he was not speaking from the point of view of a member of the Gas Committee, because it did not make the slightest difference to them—before entering upon the electric lighting of the streets to count the cost. Let them look at the case of the City of London and other large cities which had taken the electric lamps down and scrapped them. If they were determined to carry the matter through, he should not oppose them. In conclusion, he submitted a resolution to the effect that the Council should apply to the Local Government Board for a loan of £2000, and the report and resolution were adopted.

COVENTRY GAS AND WATER SUPPLY.

Early Works and Progress.

In the centenary edition of the "Coventry Herald," which has recently been published, the following particulars are given of the early works for, and the progress of, the supply of gas and water in the city.

It was in 1821 that gas first came to be used in Coventry; before then the streets were feebly illuminated by oil-lamps. The gas-works in Hill Street were privately erected in 1821, at a cost of £20,000, and were afterwards carried on by a Company. In 1856, the Company obtained powers to supply Allesley, Coundon, Stivichall, Foleshill, Radford, and Stoke. About that time the works were partially rebuilt, extended, and improved. The Corporation acquired the gas undertaking in 1884 for £168,800. Then the charges were 3s. per 1000 cubic feet inside the city, and 3s. 6d. and 4s. outside. Now it is as low as 1s. 9d. During the last year of the Gas Company, the consumption amounted to 184,855,000 cubic feet; for the year ended March, 1907, it was 811,320,000 cubic feet. In 1896, the necessity for increasing the output led the Council to sanction the erection of water-gas plant, at a cost of £7000; and the following year it was decided to duplicate it, which involved the expenditure of another £3500. In 1899, the existing works being found to be too cramped for the increasing needs of the city, it was decided to erect auxiliary works at Foleshill, which, when completed, will produce 2½ million cubic feet of gas a day; but the carbonizing plant is designed to produce only half this quantity. This, however, can be increased at will. The complete scheme will allow of the manufacture of 15 million cubic feet of gas per day. The last published accounts of the Gas Department show that the borrowing powers exercised for gas purposes by the Corporation amount to £426,308. The sum paid over from the gas profits in relief of the rates since 1884 is £46,614.

Almost the middle of the last century was reached before the city was provided with a public water supply. Before then recourse was had to various wells and springs in different parts of the city, some of which were originally placed at the disposal of the inhabitants hundreds of years ago by benevolent citizens. For more than 200 years—from 1632 to 1846—water-works at Swanswell supplied a large number of inhabitants; and there was a smaller supply from the Conduit Meadow, near the Allesley Road, which for many years provided for the needs of the Spon Street district. The Spon End Water-Works were erected in 1847, at a cost of £20,000; and at that time there were at least 30 public wells, pumps, and conduits for the use of the inhabitants, as well as numerous pumps on private premises or for the joint use of particular districts, so that the city may be said to have been fairly well off for water. The first supply from the Spon End works was obtained by annexing the Spon End spring and group of springs in the Conduit Meadow. This was for some time adequate; but as additional houses became connected, and as water-closets came into use, it was found necessary to bore. At Spon End, in all, there are five boreholes, exclusive of one which tapped salt water, and consequently had to be promptly plugged. The Whitley works date from 1895. The rapidly increasing population in the last few years has greatly taxed the available supplies; and now, as already recorded in our columns, the Corporation have an arrangement with the Birmingham Corporation to take water from their reservoir at Shustoke. The water-works have usually realized substantial profits; the amount paid from them in relief of the rates in the last financial year being no less than £4000.

* This remark referred to a failure of the electric light on the Saturday night preceding the meeting of the Council; and it was received with laughter and applause.—Ed. J.G.L.

INCREASED STORAGE AT THE PENZANCE GAS-WORKS.

Inauguration of a New Three-Lift Holder.

In the presence of a numerous assembly, a new three-lift gasholder, having a capacity of 130,000 cubic feet, erected for the Penzance Gas Company by Messrs. Willey and Co., of Exeter, was brought into use for the first time last Tuesday, when Miss Norah E. Chirgwin, the daughter of Mr. P. T. Chirgwin, the Chairman of the Company, opened the outlet-valve and allowed the gas to flow into the mains. On behalf of Messrs. Willey and Co., Mr. F. Templar Depree, J.P. (Chairman of the Directors), presented her with a magnificent silver-mounted toilet set in case, as a memento of the occasion. Each article bore the recipient's initials, and a silver plate on the case was inscribed: "Presented to Miss Norah E. Chirgwin, on her opening the extension of the Penzance Gas-Works, April, 1908." In returning thanks for his daughter, Mr. Chirgwin remarked that for some two or three years the Penzance Gas Company had felt the necessity of increasing the storage capacity of gas at their works, and in the end they had been compelled to do so. During the past ten years, the consumption of gas had increased from 30 million to 45 million cubic feet per annum, which would show that the town was not only going ahead, but that the Directors of the Company fully appreciated the fact that gas was a commercial commodity, and were doing their best to increase its sale and make its use more general. With the installation of the additional storage plant, a purifier, &c., they were extending the field of their supply, and within the next few months they were going to extend their mains to Newlyn. He trusted that the Company would go on and prosper, and that in future what work had to be done in connection with their plant would be carried out in as true and faithful a manner as was the case in connection with their present extension. The Directors were more than pleased with the way in which the Contractors had done their work. The company were then conducted over the works by the Manager (Mr. W. Nicholls); and subsequently, at the invitation of the Directors of Messrs. Willey and Co., they were entertained at luncheon at the Western Hotel—Mr. Depree presiding. In proposing "Success to the Penzance Gas Company," Mr. J. W. Buckley, the Gas Engineer of the Devonport Corporation, who is one of the shareholders, said the Company had made marvellous progress. The increase of 50 per cent. in the consumption of gas, referred to by Mr. Chirgwin, compared favourably with other towns. Acting on his (Mr. Buckley's) advice about four years ago, they entered upon some very important extensions; and it was the completion of these they had witnessed that day. The present plant would enable them to cope with another 50 per cent. increase without further capital expenditure. No gas-works on that side of the Tamar were more economically managed than those of the Penzance Gas Company. In acknowledging this toast, Mr. Chirgwin said Mr. Buckley was connected with the Penzance Gas Company some years ago, and the Directors had always received the soundest advice from him. During the past ten years their production of gas had increased one-third, and the leakage had been reduced from 13 to less than 8 per cent. Mr. Nicholls also responded. Among the other toasts was that of "The Contractors," proposed by Mr. Chirgwin, and responded to by Messrs. F. T. Depree and S. Simpson.

YORK ELECTRICITY UNDERTAKING FINANCES.

Local Government Board Inspector's Comments.

The financial affairs of the York electricity undertaking were dealt with at some length last week in the course of an inquiry by Mr. H. R. Hooper, of the Local Government Board, into an application by the City Council for sanction to borrow £25,285.

It was explained by the Town Clerk (Mr. H. Craven) that the sum represented what had been over-spent without previous sanction, and also expenditure on various other works. The figures were based on the accounts up to March 31, 1907. Since then there had been further expenditure; and, if the Inspector desired the figures brought up to March 31 last, he would ask for the inquiry to be adjourned for the purpose. The Inspector said this would be most desirable; and he asked for information as to how the Corporation proposed to meet the additional expenditure which they might be called upon to incur in future. The Town Clerk replied that estimates should be prepared for the ensuing two years, based on the average of the last five years; and the Inspector then went on to remark that the capital expenditure had been very heavy, and there must be an end to spending money in excess of powers. He emphasized the necessity for keeping strict account of the expenditure on each separate portion of the undertaking, and said the Board would not sanction loans for public lighting under suspense accounts—this must come in under an application for new works. The Electricity Engineer (Mr. Hame) having stated that expenditure on public lamps had been included in the cost of mains, the Inspector replied that money sanctioned for mains could not properly be spent on lamps. Lamps would not last half as long as mains; and if there was a period for repayment, the lamps were worn out long before the time expired. It was absolutely essential that, where a corporation had a trading concern, they should know what everything had cost; and the custom in vogue by the York Corporation must stop, and in future all expenditure on public lighting must be kept separately. Referring to the last loan, he inquired if they could tell him exactly what had been spent on public lighting. Mr. Hame: I could not. I can furnish you with the cost per arc lamp. The Inspector: If you do not know what your capital expenditure has been, how can you say whether it is costing you more or less than any other form of lighting, or whether it is better? The whole *crux* of the question is, What are you spending on the lighting, and are you getting benefit from it?

In adjourning the inquiry until June 2, the Inspector said the Local Government Board would require in the meantime a special resolution from the Council stating that in future all expenditure under each separate sanction of the Board shall be kept quite separate. All extension of public lighting must be applied for as new work, and the Board furnished with the plans and estimates. He would also require information as to the price of gas, the number and cost of lamps, &c.

The Directors of the Tarapaca Water-Works Company announce a final dividend of 4 per cent., less tax; making, with the interim dividend, 7½ per cent. for the year 1907.

WOLVERHAMPTON WATER-WORKS.

Extensions at the Tettenhall Pumping-Station.

For some time past, operations have been in progress at the Tettenhall pumping-station of the Wolverhampton Corporation, with the object of extending the water supply of the borough. The inauguration of the scheme took place a few days ago, and was made the occasion of a special ceremony, which was attended by the Mayor (Mr. Fred Evans) and members of the Corporation.

On the arrival of the company at the station, the Water Engineer (Mr. E. A. B. Woodward, Assoc.M.Inst.C.E.) made a short statement in regard to the proposals of the Water Committee. He said that from the small works constructed by the Wolverhampton Water Company under their Act of 1845—works which yielded about 150,000 gallons of water per day—the concern had now distributed an average quantity of 3¼ million gallons per day throughout an area beginning at the boundary of Shifnal and ending at the boundary of Walsall; embracing twenty townships or parishes, with a total area of 42,750 acres. The population now supplied was estimated at 155,000. The existing works were capable of yielding slightly more than 4 million gallons per day; and with the extension of the Tettenhall works it was anticipated that an additional yield of between 1½ and 2 million gallons per day would be available for distribution. Some surprise had been expressed that application should have been made to Parliament for sanction to construct works in the neighbourhood of Worfield, when it became known that in the immediate vicinity of Wolverhampton a considerable quantity of underground water could be obtained. An idea prevailed that but for the rejection of the Water Bills by Parliament the scheme now under way would not have been entertained. He desired to remove any possibility of misapprehension on this score. He reminded his hearers that in December, 1900, he recommended the Water Committee to acquire by purchase from the Staffordshire and Worcestershire Canal Company authority to extend these works, and that this should be treated as an improvement of the undertaking, and be paid for by contributions from the reserve fund. The Committee adopted his recommendations; and it was only when negotiations with the Canal Company failed, that parliamentary powers were sought. He did not hesitate to say that had such Bills not been promoted they would have overcome the Company's objection to the deepening of the wells at the station. He hoped this would show once and for all that the present scheme was not an after-thought consequent upon the rejection of the Bills. He then went on to give some particulars of the new works. He said that in the first place a reservoir was to be erected to hold 6 million gallons, with a depth of water of 16 feet; the measurements inside the wells being 299 feet and 189 feet. The walls would be 8 feet thick at the floor level, tapering down to 1 ft. 6 in. at the top of the embankment. Next came the sinking of two boreholes 28 inches diameter from the surface of the ground to 300 feet deep, 24 inches diameter to 450 feet, and gradually reduced to 12 inches from 930 feet to 1000 feet deep. An engine-house was to be built internally 50 feet long, 21 feet wide, and 50 feet high. A vertical triple-expansion engine would be installed; and an additional 24-inch pumping-main put down from Tettenhall to

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 146.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Apl. 10	10	Alliance & Dublin 10 p.c.	19¾—20½*	..	4 17 7
268,324	10	,,	7	Do. 7 p.c.	13⅜—14⅝*	..	4 13 4
310,000	Stk.	Jan. 16	4	Do. 4 p.c. Deb.	100—103	..	3 17 8
200,000	5	Oct. 30	6½†	Bombay, Ltd.	6⅜—6⅝	..	4 16 4
40,000	5	,,	6½†	Do. New, £4 paid	4⅜—5	..	5 4 0
50,000	10	Feb. 27	14	Bourne-mouth Gas and Water	10 p.c.	..	5 0 0
51,810	10	,,	7		B 7 p.c.	..	4 3 7
53,200	10	,,	6		Pref. 6 p.c.	..	4 0 0
380,000	Stk.	,,	12½	Brentford Consolidated	242—247	..	5 1 3
300,000	,,	,,	9½	Do. New	180—185	..	5 2 8
50,000	,,	,,	5	Do. 5 p.c. Pref.	118—123	..	4 1 4
206,250	,,	Dec. 13	4	Do. 4 p.c. Deb.	100—105	..	3 16 2
220,000	Stk.	Mch. 12	11¾	Brighton & Hove Orig.	195—205	..	5 9 9
246,320	,,	,,	8½	Do. A. Ord. Stk.	152—157	..	5 5 1
460,000	20	Mch. 27	10	British	41½—42½	..	4 15 1
104,000	Stk.	Feb. 13	6	Bromley, Ord. 5 p.c.	116—119	..	5 0 10
165,700	,,	,,	4⅜	Do. do. 3⅜ p.c.	86—89	..	5 1 2
500,000	10	Oct. 11	7	Buenos Ayres (New) Ltd.	11½—12	..	5 16 8
250,000	Stk.	Dec. 13	4	Do. 4 p.c. Deb.	93—95	..	4 4 3
150,000	20	Mch. 12	7½	Cagliari, Ltd.	25—26	..	5 11 6
100,000	10	—	—	Cape Town & Dis., Ltd.	4—6	..	—
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.	7—9	..	5 0 0
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	48—50	..	6 0 0
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	92—94	..	4 15 9
157,150	Stk.	Feb. 27	5	Chester 5 p.c. Ord.	105½—107½	..	4 13 0
1,493,280	Stk.	Mch. 12	5⅝	Commercial 4 p.c Stk.	104—109	..	4 15 5
560,000	,,	,,	5	Do. 3½ p.c. do.	100—105	..	4 15 3
475,000	,,	Dec. 13	3	Do. 3 p.c. Deb. Stk.	82—84	..	3 11 5
800,000	Stk.	,,	6½	Continental Union, Ltd.	115—120	..	5 8 4
200,000	,,	,,	7	Do. 7 p.c. Pref.	140—145	..	4 16 7
460,170	Stk.	—	5½	Derby Con. Stk.	122—123	..	4 9 5
55,000	,,	—	4	Do. Deb. Stk.	103—105	..	3 16 2
148,995	,,	Mch. 31	5	East Hull 5 p.c. Ord.	100—103	..	4 18 7
486,090	10	Jan. 30	12	European, Ltd.	23—24	..	5 0 0
354,060	10	,,	12	Do. £7 10s. paid	16½—17½	..	5 2 10
15,182,590	Stk.	Feb. 13	4 1/10	Gas-light and Coke	4 p.c. Ord.	..	4 9 9
2,600,000	,,	,,	3⅜		3½ p.c. max.	..	3 17 9
3,799,735	,,	,,	4		4 p.c. Con. Pref.	106—109	..	3 13 5
4,193,975	,,	Dec. 13	3		3 p.c. Con. Deb.	83—85	..	3 10 7
258,740	Stk.	Mch. 12	5	Hastings & St. L. 3½ p.c.	93—95	..	5 2 0
82,500	,,	,,	6½	Do. do. 5 p.c.	112—115	..	5 13 1
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	19—20	..	5 10 0
4,940,000	Stk.	Nov. 14	8	Imperial Continental	179—181	..	4 8 5
473,600	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	93—95	..	3 13 8
195,242	Stk.	Mch. 12	6	Lea Bridge Ord. 5 p.c.	113—118	..	5 1 8
561,000	Stk.	Feb. 27	10	Liverpool United A	221—223	..	4 9 8
718,100	,,	,,	7	Do. B	161½—163½	..	4 5 8
306,083	,,	Dec. 30	4	Do. Deb. Stk.	106—108	..	3 14 1
152,736	Stk.	Feb. 13	7⅝	Maidstone 5 p.c.	136—141	..	5 8 2
75,000	5	Nov. 28	5	Malta & Medn., Ltd.	4¼—4¾	..	5 5 3
560,000	100	Apl. 1	5	Met. of	5 p.c. Deb.	103—102	..	4 18 0
250,000	100	,,	4½	Melbourne	4½ p.c. Deb.	99—101	..	4 9 1
541,920	20	Nov. 14	3½	Monte Video, Ltd.		10⅜—11¼	..	6 1 9
1,775,892	Stk.	Feb. 27	4⅝	Newc'tle & G'tesh'd Con.		106—107	..	4 6 5
418,463	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.		87—88	..	3 19 7
15,000	10	Feb. 27	10	North Middlesex 10 p.c.		20—21	..	4 15 3
55,940	10	,,	7	Do. 7 p.c.		13½—14½	..	4 16 7
300,000	Stk.	Nov. 28	7†	Oriental, Ltd.		142—145	..	4 16 7
60,000	5	Mch. 27	7	Ottoman, Ltd.		6—6½	..	5 7 8
398,490	5	Oct. 30	7	Primitiva Ord.		6¾—7	..	5 0 0
796,980	5	Jan. 30	5	Do. 5 p.c. Pref.		4⅝—5⅛	..	4 17 7
488,900	100	Dec. 2	4	Do. 4 p.c. Deb.		93—95	..	4 4 3
1,000,000	10	Oct. 11	8	River Plate Ord.		13½—14	..	5 14 4
312,650	Stk.	Dec. 30	4	Do. 4 p.c. Deb.		93—95	..	4 4 3
250,000	10	Apl. 10	8	San Paulo, Ltd.		13¾—14	..	5 14 4
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.		50—52	..	4 16 2
135,000	Stk.	Mch. 12	10	Sheffield A		244—246	..	4 1 4
209,984	,,	,,	10	Do. B		244—246	..	4 1 4
523,500	,,	,,	10	Do. C		244—246	..	4 1 4
70,000	10	Nov. 14	10	South African		14½—15½	..	6 9 0
6,429,895	Stk.	Feb. 13	£⅝	South Met., 4 p.c. Ord.		121—123	..	4 6 8
1,895,445	,,	Jan. 16	3	Do. 3 p.c. Deb.		83—85	..	3 10 7
209,820	Stk	Mch. 12	8	South Shields Con. Stk.		154—156	..	5 2 7
605,000	Stk.	Feb. 27	5⅓	S'th Suburb'n Ord. 5 p.c.		116—119	..	4 9 7
60,000	,,	,,	5	Do. 5 p.c. Pref.		118—121	..	4 2 8
117,058	,,	Jan. 16	5	Do. 5 p.c. Deb. Stk.		120—125	..	4 0 0
502,310	Stk.	Nov. 14	5	Southampton Ord.		107—112	..	4 9 3
120,000	Stk.	Feb. 27	6¾	Tottenham	A 5 p.c.	120—125	..	5 8 0
398,940	,,	,,	5¼	and	B 3½ p.c.	101—104	..	5 1 0
149,470	,,	Dec. 13	4	Edmonton	4 p.c. Deb.	99—102	..	3 18 5
182,380	10	Dec. 30	8	Tuscan, Ltd.		10¼—10⅜	..	7 8 10
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.		99—101	+1	4 19 0
193,742	Stk.	Feb. 27	5	Tynemouth 5 p.c. max.		105—107	..	4 13 6
255,636	Stk.	Feb. 13	6½	Wandsworth and Putney	B 3½ p.c.	128—133	..	4 17 9
80,075	,,	Dec. 30	3		3 p.c. Deb. Stk.	73—78	..	3 16 11
845,872	,,	Feb. 27	5⅛	West Ham 5 p.c. Ord.		99—102	..	5 0 6
185,000	,,	,,	5	Do. 5 p.c. Pref.		118—120	..	4 3 4
228,300	,,	Dec. 30	4	Do. 4 p.c. Deb. Stk.		102—107	..	3 14 9

† Next dividend will be at this rate. Prices marked * are "Ex div."

Goldthorn Hill by way of Compton and Finchfield. New trunk mains would be laid from it to the existing mains, so that repairs could be effected without stopping the supply of the whole district. At Essington, a storage-tank for 30,000 gallons of water was to be erected.

At the close of his remarks, Mr. Woodward invited the Chairman of the Water Committee (Alderman Marston) to perform the ceremony of commencing the excavation of the reservoir and setting the boring machinery in motion. Alderman Marston then, amid applause, turned the first turf for the reservoir, and started the machinery for the permanent boring operations. The Mayor proposed a vote of thanks to Alderman Marston, and referred to the excellent public service he had rendered as Chairman of the Water Committee, and the personal sacrifices he had made for the Corporation. He expressed the hope that Alderman Marston would live to see the work he had started brought to completion, and be a great benefit to the community he had served so well. On behalf of the Committee, he asked him to accept a silver rose-bowl, bearing a suitable inscription, as a token of their appreciation of his services and of their personal regard for him as Chairman. Afterwards, Mrs. Marston was presented with a silver cake-basket.

In acknowledging the gifts, Alderman Marston said more water was needed for Wolverhampton; it was believed the new scheme would be sufficient for 25 or 30 years. Water was being pumped at the rate of 800,000 gallons per day, and no doubt more than 1,000,000 gallons could be raised. At present about 21 gallons per head of the population were being supplied to the borough; and assuming that the increase was 2½ per cent., they would be well set up. The quality of the water was first-class, and with the additional boreholes expectations would be realized. Mr. Woodward had the confidence of the Committee, and he had carried out the designs and work without outside assistance. Nothing that Mr. Woodward had put his hand to since his appointment had gone wrong. The three contracts given out were below the estimate submitted to the Local Government Board and the Corporation, which was another evidence of Mr. Woodward's capability. The capital cost of the undertaking had been upwards of £300,000; but they had paid off sufficient to reduce it to £232,000. Alderman Marston defended the expenditure of £10,000 on the compact with Colonel Kenyon-Slaney; saying it was one of the best things the Corporation ever did, for it had stopped all grievances. In addition, the Colonel had given them a valuable concession in allowing the ropeway for the railway to the Cosford Station, the result of which had been a net saving of £358 on the year's haulage of coal. So that what some gentlemen thought a rash step had turned out to the advantage of Wolverhampton. The proceedings then closed, and the company were entertained to tea by Alderman Marston.

The famous old Garrison Church in Berlin was destroyed by fire on Monday night last week. According to the "Daily Telegraph," the outbreak was thought by some to have been caused by an electric short-circuit; others, however, believed the fire to be the work of incendiaries.

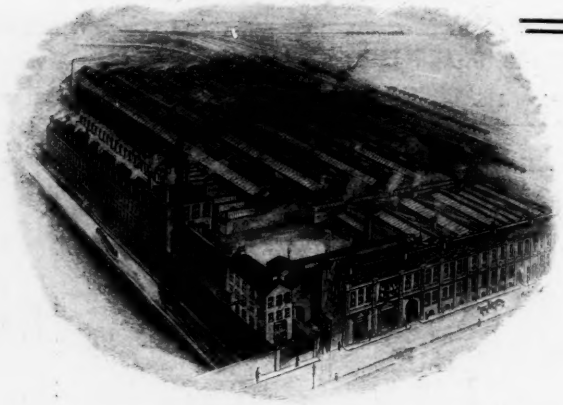
NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

A discussion took place in the Perth Town Council on Monday regarding the lighting of one of the thoroughfares of the city, which is only of consequence in so far as it gives some indication of the attitude of public men towards the undertakings under their charge—and, in this instance, shows that their interest is not always the outcome of intelligible intellectual application. The subject was whether Marshall Place should be lighted by electricity or by gas. Bailie Macpherson moved that it be by electricity. Mr. Calderwood, in seconding, is reported as having "given numerous illustrations as to the great improvements that would be effected were the newer illuminant introduced." Mr. Crystal, it is further stated, "amid several amusing interruptions, held that they should await a report from the Gas Manager." Dean of Guild Wotherspoon was of opinion that incandescent gas lighting was of no use in Marshall Place, where the lamps were exposed to all the storms from the south-west. It was, in his opinion, the duty of the Council to encourage the use of the electric light. He was very much surprised at the attitude of Mr. Crystal, who, as Convener of the Tramways Committee, used to cry for a cheaper rate for current. How, he asked, could they give a cheaper rate for current if the town did not help the Electricity Department? Mr. Hamilton, the Convener of the Gas Committee, considered it was their duty to take the light which would be best and cheapest for the community. He was, therefore, in favour of the matter being further considered. Mr. Alexander contributed to the discussion the silly notion that the lighting of Marshall Place was at present so bad that on a recent evening he almost required a light to see where the lamps were. He strongly supported Bailie Macpherson's motion. Mr. Macnab, the Convener of the Electricity Committee, argued in favour of popularizing the electric light more than had been done. He complained about the excessive quantities of leaflets which were issued by the Gas Department in praise of their illuminant. There was no doubt that the distribution of this literature prejudicially affected the use of the electric light; and he should like to know on whose authority it was done. If the practice were continued, the Electricity Department would resort to similar measures. The Council, by 14 votes to 7, resolved that electric lighting should be introduced. This resolution, it is to be noted, was adopted without waiting to learn what the Gas Engineer had to say on the subject.

In Musselburgh, the streets are largely lighted by electricity, supplied by a Company; but the service is not satisfactory. So much is this the case that, at a meeting of the Town Council on Tuesday evening, the Cleaning and Lighting Committee recommended that, in respect that there had been no perceptible improvement in the electric lighting of the town streets, the Council should not pay the quarter's lighting bill, but should call in the arbiter to report on the lighting, and should instruct the Burgh Surveyor to prepare an estimate of the cost of re-erecting the gas-lamps which had been displaced by the electric



AN

EXPERT'S OPINION.

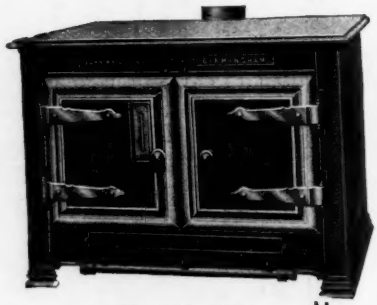
MORE NEW THINGS FROM ESSEX WORKS.

During tests made by a leading Confectionery Expert, he found **Four Tiers** of Pastry were

BAKED IN

The "VICTOR"

more satisfactorily and quicker than in the best Superheated Steam Ovens, and **Two Tiers** of Loaves were baked with equally good results.



The "VICTOR."

JOHN WRIGHT & CO., BIRMINGHAM.

light installation, with the view of reverting to gas lighting on the expiry, in December, 1909, of the agreement with the Electricity Company. The Council, by a majority, agreed to the recommendation.

The Lerwick Town Council, who are considering the propriety of effecting a gas transfer, had the subject before them again at their meeting last week. On the previous occasion, they resolved to procure information regarding the working of the De Laitte system of gas lighting. They had now before them a letter from Mr. W. N. Veitch, of Hoddom Castle Estate Office, Ecclefechan, Dumfriesshire, in which particulars were given regarding an installation which was fitted up in the village of Ecclefechan by Mr. Brook, of Hoddom Castle. It was stated that the cost of a water-driven plant capable of lighting at the same time 510 lamps of 50-candle power each, divided into three units to form a guarantee against breakdowns, would be £776. There are 950 lights installed in Ecclefechan; and the gas is used for lighting public places and private houses, and also for heating and cooking. The cost to consumers is 2s. 6d. per 1000 cubic feet. The approximate cost of manufacture is 1s. 6d. per 1000 cubic feet. The gas, it was added, gives a very fine light; the writer describing it as "quite equal to electric light, and superior to acetylene, as it does not freeze nor condense in the pipes." The letter was allowed to lie on the table. I presume that water power for the driving of machinery is not very plentiful at Lerwick, or, if there should be sufficient water available, that it would be liable to get frozen in winter, when gas is most needed; and that therefore any system of lighting which required water power would be frequently interrupted.

As a further step in the somewhat slow process of providing a new water supply for the city of Aberdeen, there has been published this week a report by Professors Hamilton and Matthew Hay, both of Aberdeen, upon weekly chemical and bacteriological examinations of the water supply which have been made by them since November, 1906. The water is all derived from the River Dee. In the report, it is stated that the analyses have shown a remarkably small proportion of saline matter; being in this respect much above the usual standard of water supplies. But the proportion of saline matter, so long as it is not in great excess, is usually no criterion of the potable quality of a water. It might be remarked, however, that the water supply of the city exhibited a somewhat curious increase of chlorides during the first three months of 1907; the chlorides increasing to nearly double their usual amount. It was apparently not due to sewage pollution, for a sample of water from the Dee above Braemar gave also an increase of chlorides, although not quite so large as in the water supplied within the city. The amount of "free ammonia" and of "albuminoid ammonia" was usually within the recognized limits for a potable river water; but on some occasions the limit for albuminoid ammonia was exceeded. The same remark was true of the proportion of "oxidized nitrogen" and "oxygen consumed." There were thus indications that, at times, the organic matter in the water was greater than what is desirable in a good water. As regarded the bacteriological examination, the results were more decisive, especially in reference to the *bacillus coli*. The number of germs or germ-colonies growing at 20° C. (68° Fahr.) varied from 90 to 2770 in 1 c.c. (15 drops) of the water; but both these figures were exceptional—the usual range being from about 200 to 700. The maximum limit for a good river water was usually stated at 500. The number of germs growing at the temperature of the human body (37° C., or 98·6° Fahr.) varied from 2 to 58, but was seldom above 20. The maximum limit for a good river water was put at 50. Judged by the standards given, the water was therefore usually within the recognized limits in respect of the so-called germ-counts, though it occasionally considerably exceeded these limits, especially after heavy winter rains. In view, therefore, of the results of their examination of the water supply, and of their knowledge of the impracticability of adequately protecting the river against domestic pollution, they had no hesitation in expressing the opinion that the water supply of the city, in its present condition, was dangerous, and that steps should be taken either to filter the water or to obtain a supply from a source not open to domestic pollution. Filtration of the present supply is, in any case, advisable to remove the turbidity so frequently observed after wet weather.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *April* 16.

Sulphate of Ammonia.

Although business has been disturbed to some extent by approaching holidays, demand has been good for immediate and near delivery, and again there has been a slight improvement in values. The closing quotations are £12 8s. 9d. per ton f.o.b. Hull, £12 10s. to £12 11s. 3d. per ton f.o.b. Liverpool, and £12 12s. 6d. per ton f.o.b. Leith. Business for forward delivery is hindered by divergence between the ideas of makers and those of buyers. Some business has been done for delivery over the summer months at £12 5s. per ton; but for July-December delivery, £12 7s. 6d. per ton is still required f.o.b. at the best ports.

Nitrate of Soda.

This article is somewhat easier, and spot prices are now 10s. 7½d. per cwt. for 95 per cent., and 10s. 10½d. for refined quality.

LONDON, *April* 16.

Tar Products.

The markets are quiet, owing to most of the works having closed for the Easter Holidays. Pitch is unchanged. Business has again been done on the east coast at 19s. per ton, and in London at 20s. 6d. Forward business in London could only be done at 21s. Benzols are all very quiet. For immediate shipment in the North, 7½d. to 7¾d. is asked. Toluol is almost unsaleable. Solvent naphtha has been sold in London at 11d. for the best qualities, and 10d. for ordinary makes. Creosote is difficult of sale for both prompt and forward delivery. Salts are very

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quiet. Carbolic acid is unchanged; and Continental consumers will not pay more than 1s. 6d. f.o.b. east coast.

The average values during the week were: Tar, 12s. to 16s. 6d. *ex* works. Pitch, London, 20s. to 20s. 6d.; east coast, 19s. to 20s.; west coast, 19s. to 20s. f.a.s. Benzol, 90 per cent., casks included, London 8¼d. to 8½d., North 7¼d. to 7⅜d.; 50-90 per cent., casks included, London 8d., North 7¼d. to 7½d. Toluol, casks included, London 8½d. to 8¾d.; North, 7½d. to 7¾d. Crude naphtha, in bulk, London 3⅛d. to 3⅜d., North 3d. to 3⅛d.; solvent naphtha, casks included, London 9⅝d. to 10d., North 8¾d. to 9d.; heavy naphtha, casks included, London 10½d. to 11d., North 9½d. to 10d. Creosote, in bulk, London 2⅜d.; North, 2d. to 2¼d. Heavy oils, in bulk, 2⅜d. Carbolic acid, 60 per cent., casks included, east coast 1s. 6½d. to 1s. 7d.; west coast, 1s. 6d. to 1s. 6½d. Naphthalene, £4 10s. to £8 10s.; salts, 35s., packages included and f.o.b. Anthracene, "A" quality, 1½d. to 1⅝d. per unit, packages included and delivered.

Sulphate of Ammonia.

This article is very firm, and prices are practically unchanged, except at Leith, where it is reported that £12 12s. 6d. has been secured for prompt delivery. The principal London Gas Companies are out of the market, but are quoting nominally £12 12s. 6d. Ordinary qualities may be secured at £12 7s. 6d. on Beckton terms. In Hull, business has been done at £12 7s. 6d. for prompt; and in Liverpool, £12 8s. 9d. has been paid. In Leith, £12 11s. 3d. to £12 12s. 6d. was paid during the past week.

COAL TRADE REPORTS.

Lancashire Coal Trade.

It is not so much the price of coal that is troubling people who have most to do with it just now; what is uppermost in men's minds is the Eight Hours in Mines Bill. Colliery proprietors do not want it, although they have a remedy should it become law; they have simply to raise their prices. It is the big and some of the little consumers who are making great efforts to thwart the measure. The demand for coal of all sorts continues firm. There is no change in prices to report at present.

Northern Coal Trade.

There has been a full production of coal, and a heavy shipment. The holidays have, however, interrupted both, and have made the position irregular and the prices varied for any quantities promptly needed and obtainable. For best Northumbrian steams, the current quotation is 13s. 6d. per ton f.o.b. For second-class steams, about 12s. per ton is the rule; and for steam smalls from 7s. to 7s. 6d. It is possible that the values may alter considerably after the output is full again. In the gas coal trade, there have been heavy deliveries for export, and fair quantities have been shipped coastwise. The current prices for Durham gas coals vary from about 10s. 6d. to 11s. 3d. per ton f.o.b. for ordinary qualities, while for special kinds about 12s. per ton is the current quotation. More of the contracts for the London gas companies have been closed; but the actual prices settled are not yet declared, though it is believed that the figures will vary from about 10s. 2d. to 10s. 6d. per ton f.o.b., according to the qualities. Of course, a large part is sold at prices in the Thames, and the rate of freight has to be estimated in these cases, which may for such contracts affect the figures. But substantially it is believed that the prices named will be near the mark for coal f.o.b. In coke, the market seems generally active; but gas coke in some cases is quieter. The current quotations for good gas coke vary from about 14s. to 14s. 9d. per ton f.o.b.

Scotch Coal Trade.

Reports as to the Home trade are that it is quiet. This will favour the view of the coalowners in the proceedings before the Conciliation Board regarding the miners' wages, in which, it may be mentioned, Lord Ardwall has again agreed to act as sole Arbiter. There is more demand in the foreign trade, which is to be expected as ice-bound ports open. The prices quoted are: Ell 10s. 9d. to 12s. 6d. per ton f.o.b. Glasgow, splint 11s. to 11s. 3d., and steam 10s. 6d. to 10s. 9d. The shipments for the week amounted to 274,383 tons—an increase of 14,378 tons upon the previous week, and of 72,144 tons upon the corresponding week of last year. For the year to date, the total shipments have been 3,285,023 tons—a decrease of 464,723 tons upon the corresponding period of 1907.

Carbis Bay Water Supply.

An inquiry was held at Carbis Bay last Tuesday, by Mr. W. O. E. Meade-King, respecting an application which had been made to the Local Government Board for permission to borrow £3200 for works of water supply. It was explained that in 1904 sanction was given to a proposed loan of £2500 for water-works for the village, but that the scheme was abandoned on account of the opposition of the landowner. Mr. F. C. Uren, an Engineer, had since investigated the district, and recommended that a supply be obtained from two springs on Treva Moor. He proposed that the water should be raised by means of a turbine to a reservoir which would have to be constructed, and the capacity of which, he suggested, should be 31,000 gallons, equal to 1¼ days' supply. Opposition was offered to the scheme on behalf of some of the inhabitants of Carbis Bay, who urged that the cost would be prohibitive, while the margin of storage was insufficient to provide against danger of a breakdown of the pumping plant. The opponents of the scheme contended that it was desirable to enter into arrangements with the Corporation of St. Ives for a supply of water; and that if this could not be done preference should be given to another scheme prepared by Mr. Uren for obtaining water from Withen Well. In the end, it was practically agreed that the matter should stand over until the new scheme for the supply of St. Ives is completed, in order to see if a supply would be available from that source.

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Sales of Stocks and Shares.

At the Mart, Tokenhouse Yard, last Tuesday, Mr. Alfred Richards offered for sale, by order of the Directors, £3000 of 5 per cent. preference stock and a like nominal amount of 4 per cent. perpetual debenture stock of the Southgate and District Gas Company. The former was sold at from £112 to £114 per £100 of stock, and all the latter at par. On the same occasion, he placed for the Directors of the Grays and Tilbury Gas Company 400 fully-paid £10 "B" shares, ranking for a standard dividend of 7 per cent., subject to the sliding-scale (the dividend on the Company's existing "B" capital having been paid for the last four years at the rate of £5 12s. per cent. per annum), at from £10 5s. to £10 7s. 6d. each, *cum div.* as from the 1st prox. He also sold some fully-paid £10 "G" ordinary shares in the Aldershot Gas and Water Company, carrying 7 per cent. dividend, at from £14 12s. 6d. to £14 15s. each. On the same day, Mr. Charles A. Joel, in accordance with the announcement which recently appeared in our advertisement columns, sold by auction, at the offices of the Newcastle and Gateshead Water Company, £40,000 of 5 per cent. preference stock (1902) of the Company. The stock was offered in 400 lots, of £100 each; and the bidding was brisk—the whole amount being sold in just forty minutes, or at the rate of £1000 per minute. £5100 of the stock was sold at £134 10s. per cent.; £2630 at £135 per cent.; £5000 at £135 10s. per cent.; £4200 at £136 per cent.; and £23,100 at £136 10s. per cent. There was thus realized an average of nearly £136 for every £100 worth of stock. On the previous day, Mr. G. Crockwell sold 12 £10 10 per cent. shares in the Torquay Gas Company at £23 each; and 15 £10 7 per cent. shares in the same Company at £17 2s. 6d., and 17 at £16 15s. each

Londonderry Gas Company.

In moving at the general meeting of the Londonderry Gas Company the adoption of the report (which stated that the revenue account showed a profit balance of £3968, out of which the Directors proposed to pay a dividend of 10 per cent. on the old shares and 7 per cent. on the new shares, less income-tax), the Chairman, Mr. H. J. Cooke, remarked that the Company had passed through a somewhat trying year. A severe depression in trade and a sharp advance in the price of coal had been adverse factors in the situation, as well as the considerable expenditure which they had incurred in renewing and repairing several portions of their plant, which was absolutely necessary. The Directors had therefore all the more pleasure in meeting the shareholders and proposing to pay the same dividends that they had been paying for many years past. It had been the policy of the Board for some years to gradually get the works put into the most efficient and up-to-date state—a policy which would take some time yet for full completion—for the economic production of gas; and it was owing to this fact that they were able to meet the shareholders now with their present dividend, after having supplied the consumers with gas at a moderate price. The forecast regarding their new apparatus for the more economic handling of coal had been amply justified. It was giving credit where credit was due to say that a large part of the inception and the entire carrying out of the improvements had been in the hands of their Engineer, Manager, and Secretary (Mr. R. J. Skinner); and both in plan and in execution all that had been done had admirably fulfilled the purpose for which they were designed. They had a gratifying increase in the sale of cooking and heating appliances for domestic purposes; and the Directors hoped and anticipated that this would be steady and progressive, and, while serving the public, would make a fair return to them on their outlay. They looked forward to a long period of healthy vitality and increased productiveness—serving their customers with a good and economical commodity for the cheap production of light, heat, and power. The report was adopted.

Reduction in the Price of Gas at Harrogate.—It is stated in a local paper that the Directors of the Harrogate Gas Company will shortly issue notice of a reduction in the gross price of gas of 2d. per 1000 cubic feet, to take effect from the 1st of July next. It is understood that all classes of consumers will participate in the advantages of the reduction, which it appears will be equivalent to £2000 per annum in their pockets.

Gosport Water Supply.—It was officially reported at the last meeting of the Gosport Urban District Council that the Gosport Water Company had commenced their promised constant service. Much gratification was expressed at the purity of the new supply from Soberton; it being stated that the town had suffered considerably in the past through the admixture of salt water with that furnished by the Forbury and Bury wells.

Acetylene Explosion at North Shields.—Four men were injured last week in a North Shields dockyard through the explosion of an acetylene generator on board a steamer. The generator, it is stated, was in connection with an iron-cutting machine; and it was being removed from the ship's hold at the time of the accident. A hitch occurred; and a light was requisitioned, with the result that gas which still remained in the generator became ignited, burning the four men near on the face and hands. Two of the men were detained in the infirmary.

Suicide by Gas at Leeds.—The Jury returned a verdict of "Suicide while under a fit of depression, arising from illness," after hearing evidence regarding the death of a young married woman named Florence Duffett, at Leeds. It was stated that the husband came home from work and found the house door locked. Upon entering by the window, he noticed a strong smell of gas; and proceeding upstairs, he found his wife lying in bed unconscious. She had one end of a rubber-pipe in her mouth, and the other end was connected with the gas-bracket on the wall; the tap being turned full on. He removed the pipe, turned off the gas, and summoned a doctor; but despite every attention, Mrs. Duffett died. The deceased underwent an operation about fourteen months ago; and she had been rather depressed because she expected having to experience a second one.

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Gas-Workers' Wages at Birmingham.—Last week the Birmingham Gas Committee had under consideration an application by the gas-workers for increases in wages. The locomotive drivers ask for an advance of 4d. per day; and other branches of the service seek somewhat similar consideration. For all Sunday work time-and-a-half is requested. At present this rate is limited to work between the hours of 6 o'clock in the morning and 10 in the evening. The Committee have promised to give the matter most careful consideration.

Covering the Exeter Reservoirs.—In presenting the report of the Water Committee at the meeting of the Exeter City Council last Wednesday last, Mr. Wreford stated that the work of covering the Marypole Head reservoir had now been completed. The material used was ferro-concrete, and the specification provided that the covering should be tested with a load of 2¼ cwt. per superficial foot, and that the greatest deflection should not be more than 1-360th of the span. This test had been carried out by Mr. W. G. Kirkaldy, of London, and the City Engineer, with instruments of different patterns; and both gave identical readings. The deflection of the girder tested with the full load was 1-3300th of the span, or about 1-10th of what the specification allowed. This result was considered highly satisfactory; and the Water Committee proposed to proceed at once with the covering of the reservoirs at Dane's Castle.

Settlement of the Labour Trouble at Rio de Janeiro.—According to the Central News, a private telegram was received in London last Wednesday to the effect that the strike of stokers at the Rio de Janeiro Gas-Works had been settled; the men returning to work on the terms offered to them before the strike commenced.

The Loco Vapour Gaslight Company, Limited, has been registered with a capital of £20,000, in £5 shares, to acquire the business of Mr. F. C. Lynde, with his patents and rights, so far as they apply to gas machinery and apparatus in connection with the Loco vapour gas-machine and the Loco light.

The Official Receiver has issued particulars in connection with the failure of James Alexander Boggis, trading as the Gas Stove and Fittings Company, of 590, Fulham Road. The debtor's statement of affairs shows gross liabilities amounting to £597, of which £491 is due to unsecured, and £80 to secured creditors; the value of the securities being returned at £86. The assets are estimated to produce £62, from which £25 has to be deducted for the claims of preferential creditors payable in full; leaving the net assets at £37, and disclosing a deficiency of £454. The debtor attributes his insolvency to loss in trading owing to competition.

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LEAFLETS FOR DISTRIBUTION.

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No. 5.—"On Reliability, with Instances of Misplaced Confidence."
No. 6.—"On Shop Lighting, with Special Reference to the Flame Arc Lamp."
No. 7.—"The Osram Lamp: Fiction and Fact."

This series of Leaflets will be useful, not only for distribution among Householders generally, but for circulation among Shareholders to fortify them with arguments in defence of the commodity in which they have invested capital. Copies of each Leaflet should also be kept in every Gas Undertaking's Show-Rooms.
Prices for Quantities on Application to WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

GAS MANAGER. Middleton Gas Department. Applications by April 29.
FOREMAN (TAR-WORKS). No. 4934.

Situation Wanted.

BOOK-KEEPER, TYPIST, &c. No. 4924.

Instruction in Gas and Fuel Analysis.

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PURIFIERS, SCRUBBERS, ENGINES AND EXHAUSTERS, BOILERS, RETORT-BENCH MOUNTINGS, &c. British Gaslight Company, Etruria. Tenders by April 30.
GAS-WORKS PLANT. Ilfracombe Gas Company.

Tar-Works Wanted. No. 4930.

Licences to Work Under Patent.

APPARATUS FOR CLEANING FILTERS. Haseltine, Lake, and Co., Southampton Buildings, W.C.

Stocks and Shares.

ASCOT GAS AND ELECTRICITY COMPANY. April 29.
CROYDON GAS COMPANY. April 29.
DORKING WATER COMPANY. April 29.
EAST HULL GAS COMPANY. May 14.
FELIXSTOWE GAS COMPANY. May 12.
GREAT YARMOUTH WATER COMPANY. May 12.
KINGS LYNN GAS COMPANY. April 29.
NORTHFLEET AND GREENHITHE GAS COMPANY. May 12.
PINNER GAS COMPANY. May 12.
SOUTH ESSEX WATER COMPANY. May 12.
TOWN OF DUDLEY GASLIGHT COMPANY. May 11.
UXBRIDGE GAS COMPANY. April 29.

TENDERS FOR

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HINCKLEY GAS DEPARTMENT. Tenders by May 2.
INVERNESS GAS COMMISSIONERS. Tenders by April 28.
LEIGH-ON-SEA DISTRICT COUNCIL. Tenders by April 29.
MONTROSE GASLIGHT COMPANY. Tenders by April 27.
WANDSWORTH AND PUTNEY GAS COMPANY. Tenders by May 4.
WATFORD GAS AND COKE COMPANY. Tenders by May 9.

Gasholder Sheeting.

HALIFAX GAS DEPARTMENT. Tenders by April 29.

Lime.

INVERNESS GAS COMMISSIONERS. Tenders by April 28.

Retort Fittings, Mouthpieces, &c.

COVENTRY GAS DEPARTMENT. Tenders by May 4.

Retort Setting.

NEWTOWNARDS GAS DEPARTMENT. Tenders by April 30.

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